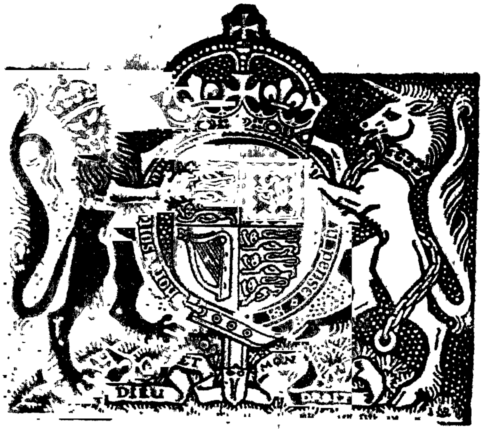
I. A. R. I. 6.


HONI SOIT QUI MAL Y PENSE
DIEU ET MON DROIT

IMPERIAL AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

I. A. R. I. 6.

IMPERIAL AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

Proceedings of the Twenty-fifth Indian Science Congress

PART III—ABSTRACTS

CONTENTS

PAGE

Section of Mathematics and Physics 1
,, ,, Chemistry 35
,, ,, Geology 107
,, ,, Geography and Geodesy 123
,, ,, Botany 131
,, ,, Zoology 155
,, ,, Entomology 173
,, ,, Anthropology 193
,, ,, Agriculture 209
,, ,, Medical Research 231
,, ,, Veterinary Research 259
,, ,, Physiology 277
,, ,, Psychology 299

SECTION OF MATHEMATICS AND PHYSICS

President :—C. W. B. Normand, M.A., D.Sc., F.N.I.

Transmutation and structure of matter

1. Lecture on 'Recent work on transmutation of matter in Cambridge'.

Lord Rutherford, Cambridge.

2. The radioactivity of samarium.

H. J. Taylor, Bombay.

The radioactivity of samarium has been reported on in a previous communication. The present paper gives an account of more recent experiments, conducted in collaboration with Messrs. D. Fraser, V. D. Dabholkar, N. V. Shah, and M. J. Gandhi. Using the method of direct registration of tracks in a photographic emulsion, a large number of measurements have been accumulated. About 5,000 expansion-chamber photographs have also been made, about 50 of which show tracks which are due to the particles emitted by samarium. In both types of experiment tracks are obtained which can scarcely be due to α-particles. They have previously been attributed to protons, assumed to be emitted by the samarium atom. The evidence for this proton emission is now very strong. Experiments have also been made to test a suggestion that the proton activity of samarium is provoked by cosmic radiation.

3. Isotopic weights by the doublet method.

F. W. Aston, Cambridge.

For the most reliable comparison of masses by mass-spectra the particles concerned should be nearly equal when the lines they produce, resolved by a mass-spectrograph of sufficient power, will form a natural doublet. A typical example is the oxygen-methane doublet ${}^{16}O - {}^{12}C^{1}H_4$ at mass 16, the first one to be observed and measured. Owing to the discovery of heavy hydrogen it is possible to apply this method to determine the fundamental isotopic weights of hydrogen and carbon in terms of ${}^{16}O$ as standard. ${}^{1}H$ is first compared with ${}^{2}D$ by means of the doublet ${}^{2}D - {}^{1}H_2$ at mass 2, ${}^{2}D$ with ${}^{12}C$ by doublet ${}^{12}C^{++} - {}^{2}D_3$ at mass 6 and the results combined with the oxygen-methane doublet to give the constants required. These comparisons can be extended wherever suitable doublets can be produced, thus ${}^{16}O^{2}D_2$ can be compared with ${}^{20}Ne$ or with ${}^{40}A^{++}$ at mass 20, ${}^{12}C_3{}^{1}H_7$ with ${}^{86}Kr^{++}$ or with ${}^{129}Xe^{+++}$ at mass 43 and so on. About 20 isotopic weights have already been determined with accuracy approaching 1 part in 100,000 in this way.

4. On the ratio of the magnetic moments of iridium isotopes.

B. Venkatesachar *and* L. Sibaiya, Bangalore.

The isotopic constitution of iridium was for the first time determined from a study of the hyperfine structure of its arc line λ3513·67 Å (Venkatesachar and Sibaiya: *Nature*, 1935, **136**, p. 437; and *Proc. Ind. Acad. Sc.*, 1935, **2**, p. 203). It was shown that iridium consists of two odd isotopes of mass numbers 191 and 193, the isotope 193 being twice as abundant as the isotope 191. This result was afterwards corroborated by Dempster's mass-spectrograph analysis. With the view of determining the ratio of the nuclear magnetic moments of the two isotopes, the hyperfine structure, arising from the nuclear spin moments of $-\frac{1}{2}\frac{h}{2\pi}$ and $+\frac{3}{2}\frac{h}{2\pi}$ of the isotopes 191 and 193 respectively, has been investigated for several iridium lines using an aluminized Fabry-Perot etalon. From the results obtained for the hyperfine level separations of the isotopes, it is concluded that the ratio of the nuclear magnetic moments of Ir 191 and 193 is −0·92.

5. Diamagnetism of cadmium.

S. Ramachandra Rao *and* S. Sriraman, Annamalainagar.

Single crystals of cadmium were prepared by the method of slow cooling and the principal magnetic susceptibilities were determined by the Gouy method. The influence of ferromagnetic impurities was duly eliminated. The mean values perpendicular and parallel to the hexagonal axis of the crystal were found to be −0·163 and −0·223 respectively. These results agree favourably with those of McLennan, Ruedy and Cohen.

The influence of cold-working on polycrystalline rods was to give a small decrease in susceptibility. On the other hand the principal susceptibilities measured with single crystals showed no variation on cold-working.

The influence of small quantities of foreign matter was also investigated. Lead when added in small amounts affected the principal susceptibility normal to the *c*-axis but not the value parallel to this axis. Small quantities of zinc did not affect the susceptibility values.

These results are examined in the light of the theory of paramagnetism of free electrons. The valency electrons appear to contribute a paramagnetic component perpendicular to the *c*-axis. There is evidence for this from electrical conductivity data. The results obtained with the alloys are examined in the light of these conclusions.

6. Secondary electron emission of nickel at the Curie point.

S. Ramachandra Rao *and* P. S. Varadachari,
Annamalainagar.

A study of the secondary electron emission from nickel has been made at different temperatures ranging from 30°C. to 385°C. at a constant applied potential. No sudden alteration in the secondary electron current was observed at the Curie point (358°C.). Our results are at variance with those of Tartakowsky and Kudrawjewa and of Hayakawa. Attention is drawn to the investigations of Rao wherein no abrupt variations were obtained in the photo-electric emission and soft X-ray excitation curves of nickel at the Curie point. It is difficult to understand how in such closely connected phenomena, anomalies exist in one class and not in the other. Support from this point of view is adduced for the conclusions of our investigations.

7. Magnetic birefringence of some aromatic hydrocarbons in the molten state.

W. J. JOHN, Calcutta.

In the present paper some of the important aromatic compounds have been studied for their magnetic birefringence in the molten state. The results are compared with those obtained by Chinchalkar and Mahajan for some of them in state of solution in suitable solvents. Their conclusions regarding the structures of these molecules and their influence on the birefringence are confirmed.

8. Diamagnetic susceptibilities and molecular structures.

K. BANERJEE *and* S. N. SEN GUPTA, Dacca.

Susceptibilities of some organic crystals have been measured with a view to determine the orientations of molecules in them. The method is fruitful only when a determination of space-group is available. The orientations of the molecules in benzamide, orthodinitrobenzene, metadinitrobenzene, phloroglucine dihydrate have been determined in that way. The estimated intensities of X-ray reflections agree well with the structures found magnetically. Three non-aromatic compounds namely, decahydro-β-naphthol, arcostenone, and guanidine carbonate have been measured. In these cases the magnetic anisotropies are extremely feeble, and so a Weiss magnet was used, and the crystals were suspended from an extremely thin quartz fibre. A more rigorous method of calculation than that used by the earlier workers was found necessary in these cases of feeble anisotropy. Orientations of the molecules in these crystals are deduced from the experimental results.

9. Electron map of anthraquinone crystal by Fourier summation method.

K. BANERJEE *and* J. BHATTACHARYA, Dacca.

X-ray diffraction from anthraquinone crystals has a unique peculiarity, that reflections from such *hko* planes for which $h+k$ is not divisible by 4 or either h or k is odd are either absent or extremely feeble. So the projection on the 001 plane has apparent translational distances of $a/2$ and $b/2$ in place of the axial lengths a and b of the original cell. Furthermore, the symmetries of the original cell will also be present in the projection of this quartered cell. For the measurements of the integrated intensities, a photographic photometrical method is developed. The spot of light in the Zeiss photometer was shortened to about ·2 mm. length, and each photographic spot was scanned along six equally spaced lines. The photometric curve was converted into intensity curve by the help of a wedge prepared by Robinson's method. The absolute integrated intensities were obtained from these relative values by comparison with the reflections from rock salt. The two-dimensional Fourier summation method of W. L. Bragg is applied to find the electron distributions and therefrom the atomic parameters are determined.

10. Oscillographic studies of the uni-polar electrical conductivity of carborundum.

J. K. BOSE *and* S. R. KHASTGIR, Dacca.

Oscillograms of alternating (50 cycles per second) voltages rectified by the carborundum crystal placed between mercury electrodes of large contact area have been taken for different voltages. Although the contact-point rectification has been avoided in these experiments, the direction of the current flow through the crystal has not been unique and definite and only an average effect for a number of directions has been observed. To study uni-polar electrical conductivity in a definite direction in the crystal, the crystal has been clamped between two similar metal contact points, and the oscillograms obtained with the crystal mounted in this way have shown considerable rectification. It has been definitely shown that the observed effect is not due to differential contact-point rectification.

The values of the rectification ratio for different voltages have been computed from the oscillograms. The computed value of the rectification ratio has been found to diminish gradually with the increase of the applied voltage. This is consistent with the theoretical idea put forward by one of us as to the origin of uni-polar electrical conductivity in carborundum.

11. Effect of intense cooling of aluminium anticathode on the *K* emission line.

K. Prosad *and* A. T. Maitra, Patna.

The paper describes the study of the effects of liquid oxygen cooling of an aluminium anticathode of a special design, on the intensity and structure changes of its *K* emission line, using an X-ray spectrograph of Siegbahn's design and having a plane grating with 600 lines to the millimeter, as compared with the intensity and structure of the line when the anticathode is cooled by the circulation of water at the room temperature. Photographs were taken on the same plate under otherwise identical conditions of exposure and development and were microphotometered.

Preliminary measurements indicate that—

(1) the intensity of the line at the liquid oxygen temperature has increased by about 40%;

(2) the spread of the line on the long wave side, observed at the room temperature, has considerably decreased at the liquid oxygen temperature and the line as a whole has become more symmetrical in structure.

Further work with aluminium and other metals is in progress.

12. X-ray diffraction pattern of some normal alcohols and their isomers.

K. Prosad *and* B. N. Ghosh, Patna.

The X-ray diffraction patterns of a number of normal and isomeric alcohols have been studied by the photographic method using CuK_α radiation filtered through 0·2 mm. of nickel. The microphotograms reveal asymmetric structure of maxima which is interpreted as the superposition effect of two very close spacings. The relative intensities of the rings and the half width of the maxima have also been measured. They throw some light on association and the nature of the 'cybotactic' fragments in the liquid state.

13. Crystallite orientation in polycrystalline metals during plastic flow.

N. Ram Lal, Hyderabad (Dn.).

In continuation of the previous work (Gibbs and Ramlal, Phil. Mag., Vol. 18, p. 949, 1934) X-ray measurements of metals (tin and magnesium) at various stages of plastic flow under relatively large stress have been made. In confirmation of the results of Andrade and Chalmers, X-ray measurements show that, when a polycrystalline metal flows, that part of the flow called the β-flow, which gradually diminishes with time is connected with a rotation of the axes of the crystallites.

14. The allotropes of sulphur—a study by the X-ray diffraction method.

S. R. DAS, K. RAY, *and* B. B. RAY, Calcutta.

A detailed investigation has been carried out into the structures of the diverse modifications of sulphur at temperatures ranging between −183°C. and 130°C. The chief experimental method involved was the powder photograph method due to Hull. The following important observations and conclusions have been made :—

1. Ordinary roll sulphur and flower of sulphur have identical crystalline structures (S_α). The rings correspond to the lattice spacings: 5·65, 3·83, 3·45, 3·13, 2·84, 2·64, 2·40, 2·24, 2·11, 1·98 and 1·91 in Å.

2. Milk of sulphur and the gummy deposits of colloidal sulphur, which have till now been regarded to be amorphous, are not so. Their patterns show that they are identical in structure with S_α.

3. Plastic sulphur, when freshly prepared, is really amorphous producing only one diffuse diffraction ring of the spacing 3·5 Å. It rapidly transforms into a hard insoluble solid mass of S_α. But it reverts to soluble S_α, if it is kept at about 90°C. for 8–12 hours or treated with NH_4OH. The fibre-like structure observed by J. J. Trillat and J. Forestier has been explained.

4. White sulphur obtained by the hydrolysis of S_2Cl_2, hitherto supposed as amorphous, has exhibited a well defined crystalline pattern, quite different from that of S_α. The Bragg-spacings observed are: 4·50, 4·02, 3·57, 3·07, 2·71, 2·3 and 2·10 Å. Heated for about 36 hours or so at about 88°C., it transforms entirely and permanently into S_α.

5. Growth of the crystal-size out of the fine powders of S_α has been evidenced by the lack of uniformity of intensity of the rings at and above 75°C. This fact, together with a tendency of S_α for transition into S_β (monoclinic S) at higher temperatures, which causes a distortion of the original crystal lattice give rise to ' asterism ', when radial streaks appear on the photograph. It has also been suggested that the transition point of $S_\alpha \rightleftarrows S_\beta$ is probably lower than the commonly accepted temperature, 95·5°C. For, the phenomenon of asterism is exhibited below it.

6. All attempts in recording a pattern of S_β failed owing, probably, to its instability at ordinary temperatures on the one hand and to the growth of size and distortion of the crystals at higher temperature on the other.

7. Liquid sulphur patterns have been obtained at 114°C., 119°C. and 128°C. and in each case only two diffuse rings corresponding to the spacing: 5·0Å and 3·46Å have appeared.

8. No appreciable change in the pattern has been observed at as low a temperature down as −183°C.

The insolubility of the various forms of sulphur has been suggested to be in some way due to the presence of SO_2 in the body of the crystallites.

General Relativity, Gravitation, Astrophysics and Spectroscopy

15. Lecture on ' Subatomic energy in the stars '.

PROF. A. S. EDDINGTON, Cambridge.

16. A law of gravitation.

S. M. Sulaiman, Allahabad.

S. M. Sulaiman has put forward the theory that the velocity of gravitation is finite. Applying this correction in Newtonian Mechanics he has derived the law of gravitational attraction as

$$-\frac{GM}{r^2}-\frac{3GMh^2}{D^2}\cdot\frac{1}{r^4}$$

where M is the gravitating mass at the origin, D is the velocity of gravitational influence and G is the gravitational constant. Treating the extra term as a small disturbing force

(1) the advance of the perihelion comes to

$$\frac{6\pi\mu^2}{D^2h^2};$$

(2) the deflection of light particle from a star past the Sun lies between

$$\frac{16\mu}{3D^2R}\text{ and }\frac{6\mu}{D^2R};$$

and (3) the spectral shift of light from any part of the Sun is

$$\frac{\mu}{D^2a}(1+\sin^2\alpha)$$

where R is the shortest distance from the Sun, a is its radius and α is the angle between the line of sight and the radius. $\mu = GM$ and D equals the velocity of light.

Equations of the orbit for $u=\frac{1}{r}$ in terms of θ and θ in terms of u have been obtained in Weierstrass's function. The Two Bodies Problem is simple. The potential function for the Three Bodies Problem also has been obtained.

17. The dual character of light.

S. M. Sulaiman, Allahabad.

If a light corpuscle be a binary system consisting of two components of equal and opposite charges rotating round each other and moving forward along their axis of symmetry, it would be an electro-magnetic phenomenon subject to Maxwell's equations. The electro-magnetic field will be both created and carried along by the system itself. In the transverse section the motion will be periodic. By using cylindrical co-ordinates, it can be shown that the system will be propagated with the characteristic velocity $\frac{c}{\sqrt{\mu k}}$ of the medium, which will be its phase velocity as well.

Such a rotating system, moving along the Z-axis and possessing both (1) momentum in the direction of z, and (2) a transverse periodic motion, would exhibit both the particle and the wave aspects simultaneously, according as the effect is observed longitudinally or transversely, thus showing the dual character of the light.

18. Lecture on ' Recent eclipse results '.

Prof. F. J. M. Stratton, Cambridge.

The study of the physical nature and conditions of those outer layers of the Sun's atmosphere which are only accessible to instrumental observation at the short period of an occasional solar eclipse is essentially one for international co-operation. The programmes and the eclipse camps of different expeditions are chosen so as to avoid undue overlapping of common observations at nearby stations and so as to secure where possible the repetition of the more important observations at stations far apart from each other. In this way the best chances are offered for progress. In the period since 1918 the following problems have been successfully tackled: (1) The deflection of a ray of light with its confirmation of Einstein's generalized theory of relativity has been observed by British, American and German astronomers. There remains the question whether there is a small deflection in excess of that predicted by Einstein and if so, what is the cause of this deflection. (2) Variations have been observed in the structure of the corona in the course of the passage of the shadow over the Earth's surface (Italy and Britain). (3) More exact measurements of the total luminosity of the corona have confirmed its variation and the absence of any simple law of brightness with height above the Sun's limb (America, Germany and Russia). (4) The fact that the polarization of the continuous spectrum of the corona is the same for all wave-lengths (France) shows that the scattering particles reflecting the sunlight must be electrons or dust particles. (5) Either of these sources of scattering is consistent with the fact that the continuous spectrum of the corona shows the same intensity distribution with wave-length as integrated sunlight (Germany). The dust particles are held to be responsible for the Fraunhoferic lines found in the outer corona. In the theory of a corona composed of electrons surrounded by a cloud of dust particles there remain outstanding difficulties which still await solution by observations at some future eclipse. (6) Still another constituent of coronal light has yet to be identified as the source of the bright lines of the coronal spectrum. A number of fresh lines have been discovered (Great Britain, America, Germany) and the fact that lines differ in relative intensity at different eclipses and at different points on the Sun's limb has been established. Day-to-day variations in the strengths of the principal lines form part of the very valuable work now being carried on by Lyot of the Meudon Observatory at the Pic du Midi, France. He has also discovered new coronal lines in the infra-red. (7) Lyot has also measured the rotation of the corona and has shown that the coronal lines are so wide that the hopes of getting more exact wave-lengths by interferometer methods must be abandoned. Thus two problems of long standing have been removed from eclipse programmes. (8) The examination of the relative strengths of lines of the same multiplet in the chromospheric spectrum has shewn a wide difference from the theoretical values for a state of thermodynamical equilibrium (Britain, Holland, America). (9) The widths of the chromospheric lines have given estimates as to the amount of turbulence available to help to support the chromosphere (America and Great Britain). The abundance of the elements in the chromosphere has been shown to be substantially the same as in the reversing layer (America). More work remains to be done on the difficult question of the variation of intensity with height of the various chromospheric lines. So far no finally satisfactory results have been secured though valuable pioneer work has been done (Holland and America). (10) The transition from the absorption spectrum to the emission spectrum of the chromosphere has been studied by the slit spectroscope (Britain), the continuously moving plate camera (America) and by a cine-camera taking 24 photographs to the second (Japan). (11) Cine-cameras have also been used for obtaining the exact times of the second and third contacts with a view to geodetic applications of the results (Poland). (12) A geophysical problem has been in large part solved by the study of wireless echoes during a total eclipse. It is now certain that the normal E layer of the ionosphere is entirely ionized by ultra-violet light from the Sun, as also at least in large part the normal F layer. A great deal of work remains to be done at future eclipses on nearly all the above topics before we can get a satisfactory knowledge of the nature, physical condition and behaviour of the upper layers of the Sun's atmosphere.

19. Theory of scattering of protons by protons.

A. S. EDDINGTON, Cambridge.

It is deduced from scattering experiments that at very close encounters the force between two protons becomes attractive instead of repulsive, so that there is a well of negative potential immediately surrounding a proton. The combination of relativity theory and wave mechanics developed in the author's *Relativity Theory of Protons and Electrons* is here applied to this problem. It is found that the existence of the potential well is a necessary consequence of the theory, and formulæ for its extent and intensity are obtained. The potential well is of Gaussian form, the energy at distance r (additional to the Coulomb energy) being $-Ae^{-r^2/K^2}$, where

$$K = 2{\cdot}20.\ 10^{-13}\ \text{cm}.$$

$$A = 39{\cdot}2\ mc^2,$$

m being the mass of an electron. The values of A and K agree with those obtained experimentally by Breit, Condon and Present.

In the corresponding problem of the encounter of two electrons, A is smaller in the ratio 1/1847, so that the well potential is much less important in comparison with the Coulomb potential.

Since the potential well in this problem is fundamentally the same as that which occurs in the theory of the nucleus, the investigation has a special interest as furnishing a connecting link between extra-nuclear and nuclear physics.

20. Pressure ionization in white dwarf stars and planets.

D. S. KOTHARI, Delhi.

The paper gives a detailed account of the theory of pressure ionization or ionization in cold matter, i.e. matter in which any free electrons present constitute a degenerate gas in the sense of Fermi-Dirac statistics. A straightforward application of the *virial* theorem leads to a relation between the mean molecular weight (per free electron) and the density or pressure of the material. The main astrophysical results which follow from an application of the theory may be summarized as follows :—

(i) The theory *predicts* that the stellar material in the interior of the white dwarf star should be almost *fully ionized.*

(ii) It predicts the existence of a maximum radius for a *cold* body. The value of this maximum radius is about the same as the radius of the planet Jupiter. Thus *there cannot be a cold body (planet or white dwarf) bigger (from the point of size) than Jupiter.*

(iii) The theory shows that the two heaviest planets (Jupiter and Saturn) have cores composed of *metallic hydrogen.* The terrestrial planets have cores of much heavier metal, possibly iron.

21. The complex spectra of novæ.

F. J. M. STRATTON, Cambridge.

The normal course of development of the series of spectra shown by a nova in the course of its bright outburst may be simply stated. A spectrum of bright undisplaced bands with absorption lines at their violet end sharing a common line of sight velocity shows changes in the widths of the bright bands, the displacements of the absorption lines and the type of spectrum present. At first the spectrum changes from an earlier (or hotter) to a later (or cooler type) and the absorption lines show a diminishing displacement while the bright bands narrow. Then a succession of absorption spectra, generally with a larger displacement and successively of earlier type emerge and in turn fade away: two such spectra are commonly present together and occasionally three such spectra can be identified as simultaneously present. As many as eight or nine such spectra can be traced before the fading away of the continuous spectrum of the star leave behind a spectrum of isolated bright bands. These pass from the *A* and *B* type, corresponding to the white and blue stars, to the *P* type corresponding to the planetary nebulæ and later to the *O* type corresponding to the Wolf-Rayet stars, the hottest known stars. The bright bands in the nebular and Wolf-Rayet stage are generally composite in structure and if the nova has grown to a measurable disc or developed into a set of multiple nuclei or condensations it may be found that different maxima in the bright bands come from different portions of the expanding nova. The velocities corresponding to the displaced maxima can frequently be related to the velocities shown by some of the earlier sets of displaced absorption lines.

The earliest simple set of phenomena can be best explained in terms of an expanding shell round a bright stellar source: the reasons why its speed diminishes at first are not known; and continuous ejection of matter from a central star may well provide the solution of some of the phenomena. The later more complex spectra require a much more elaborate model and so far no consistent picture has been formed for these later stages. It is not certain as yet whether the later more rapidly moving shells start inside the earlier ones or, like prominences on the Sun's limb, represent a sudden increase in velocity (generally to a small multiple of the earlier velocity) of the outer layers of the earlier outburst. Nor is it yet certain whether shells are to be replaced by jets of gas continuously driven off from the parent star. The study of the contours of absorption lines and bright bands, especially when successive spectral outbursts are simultaneously present should throw much light upon such questions. That the outward motion is due to increased radiation pressure, as suggested by Milne, is very probable, but the cause of the outburst of this radiation is unknown. Milne's view that we are observing the stages accompanying the collapse of an ordinary dwarf star to a white dwarf is consistent with a great many of the observed data. We do, however, need to find out more about the spectral changes of the star during its sudden rise to maximum brightness and a scheme for catching novæ at a much earlier stage than at present is highly desirable.

22. Intensity fluctuations in the continuous absorption spectra of some gaseous molecules—(HBr and HCl).

S. Datta, B. Chakraborti, *and* S. Banerji, Calcutta.

It is well known that good deal of controversy exists about the nature of binding of several gas molecules, particularly those of hydrogen halides. The discrepancy is mainly due to the fact that the long wavelength limits of continuous absorption from which the heat of dissociation is calculated, is fixed at different values by different observers.

A careful repetition of the absorption experiments was therefore felt desirable and this appears to be completely justified as the microphotometric analysis of the absorption records for varying pressures have revealed the following interesting features:—

(i) The long wavelength limit of continuous absorption slightly shifts towards longer wavelengths with an increase in pressure.

(ii) At higher pressures marked fluctuations of intensity are observed at the long wavelength beginning, somewhat analogous to those observed by Sommermeyer in the case of alkali-halides.

The curves showing the variation of percentage of absorption with wavelength have two distinct maxima. Interpreting their long wavelength limits as corresponding to transitions from the states $v'' = 0$ and 1 of the lower potential curve to practically the same point in the upper potential curve, the difference in the long wavelength limits correspond to the accepted values of the vibration quanta of HBr and HCl as obtained from the infra-red measurements.

(iii) Correlation between the spectroscopic value of the heat of dissociation and that obtained from thermal measurements appears to be satisfactory when the long wavelength limit is chosen corresponding to transitions from the state $v'' = 0$ and with the absorption tube at room temperature and at atmospheric pressure.

23. Vibrational perturbations in the lower $^2\Sigma$ state of aluminium oxide bands.

P. N. Ghosh *and* M. K. Sen, Calcutta.

From an analogy with the spectra of boron monoxide, BO, one would expect band systems yet undiscovered in the spectrum of AlO. While searching for these new band systems, the authors have recorded a number of new bands in the existing system, which is due to a $^2\Sigma \rightarrow {}^2\Sigma$ transition. It is found that the new bands with $v'' = 9$, 10, 11 and 12 are shifted from their expected positions thus giving evidence of perturbations in the lower electronic state. The perturbing state is, in all probability, a $^2\Pi$ level. Hence the existence of a new band system due to a transition $^2\Pi \rightarrow {}^2\Sigma$ and thus analogous to the α bands of BO has been predicted in the near infra-red region of the spectrum of AlO. The present communication deals with the assignment of vibrational quantum numbers to the new bands and discusses at length the perturbations existing in the lower state of the $^2\Sigma \rightarrow {}^2\Sigma$ band system.

24. A new ultra-violet band system of antimony oxide (SbO).

P. N. Ghosh *and* A. K. Sen Gupta, Calcutta.

The authors have recorded a new ultra-violet band system in the spectrum of the diatomic oxide molecule, SbO. The bands are degraded to the violet and form two sub-groups. Each band head is itself double. The system has therefore been assigned to a $^2\Sigma \rightarrow {}^2\Pi$ transition. The lower state of the band system is in all probability, the ground state of the molecule and has a doublet separation of about 2,272 cm.$^{-1}$. From a comparison with the spectra of the homologous molecules NO, PO and AsO the band system is considered to be an analogue of the γ-system. The present communication deals with the preliminary analysis of the vibrational structure of these new bands.

25. Vibration temperature in relation to rotation temperature in band spectra.

N. R. Tawde *and* S. A. Trivedi, Bombay.

The CN violet and the AlO blue-green systems have been excited in the same carbon arc as the source. Gross intensity distribution among the bands of the two systems has been made by photographing them simultaneously. Effective 'vibration temperatures' have been derived which come to be 6200° K. for CN and 3450°K. for AlO. These results compare very well with those of Ornstein and Brinkman from rotational energy distribution and point to the existence of thermal equilibrium of molecules within the upper vibrational states.

26. Study of the oxy-coal gas flame by band spectra.

N. R. Tawde *and* J. M. Patel, Bombay.

Swan system of C_2 bands has been photographed in the oxy-coal gas flame by producing the same under five different conditions. By keeping the coal-gas pressure constant, the oxygen pressure has been varied so as to get the coal-gas/oxygen ratios as 1·25, 2, 3, 4, 5. By applying the intensity laws, temperatures have been calculated for all the ratio conditions which bear with the ratios the same relation as that found by Loomis and Perott by other methods. Besides this, many other interesting aspects have been noted.

27. Rôle of argon in the production of Swan bands.

N. R. Tawde *and* D. D. Desai, Bombay.

Inert gases have been known to give rise to the production or isolation of certain spectra. This is specially so with argon which brings out the C_2 Swan system of carbon under certain conditions in the discharge tube. Argon was filled in discharge tubes at pressures of 10, 15, 20, 25 and 30 mm. and progressive intensity changes in the bands have been measured. Attempts have been made to arrive at the critical pressure of argon and the probable mechanism of the production of C_2 molecule.

28. The first spark spectrum of bromine, Br III.

K. R. Rao, Waltair.

In a former communication (*Ind. Sci. Cong.*, '37), (also *Proc. Roy. Soc.*, Vol. 161, p. 38, 1937), it was reported that extensive investigations on the spectrum of Bromine from λ500 to λ6000 led to the identification of many of the prominent multiplets of Br III. A careful assignment of the lines due to various stages has helped further in the discovery of the chief combinations of Br II lying in the very extreme and the near ultra-violet. The $4p\ ^3P$ term is found to be inverted. The intervals $4p\ ^3P_2{-}^3P_1$ and $^3P_1{-}^3P_0$ are 3147 and 691 cm.$^{-1}$ respectively. The first ionization potential of Bromine is found to be 21·1 volts.

29. The spectrum of argon IV.

A. Balankesvararao, Waltair.

Extensive investigations on the highly excited spectrum of Argon gas from λ2000 to λ6000, under various experimental conditions enabled the identification of the lines due to A IV. The prominent terms due to the $4p$, $5d$, configurations are discovered. Some of the even terms are, 248927, 246618, 259764.

30. The spectrum of iodine IV.

S. G. Krishnamurty, Waltair.

While classifying some of the intense lines of the spectrum of highly excited Iodine, for the elucidation of the structure of Iodine III, some intense lines in the visible region appeared to be due to the trebly-ionized atom. These lines along with many other lines of Iodine IV previously identified, entered into a scheme which revealed the prominent $6p$, $6s$, and $5d$ terms of I IV. The $6p\ ^3P$ term is found to present unusual anomalies as would be expected in the spectra of atoms of heavier nuclei.

31. Factors affecting the accurate determination of density by Zeiss Recording Microphotometer.

B. N. Ghosh, Patna.

The paper is concerned with investigation of various types of errors which have to be taken into account when making accurate determination of photographic density produced under varied conditions.

32. On the theory of absorption in ionized gas.

(Mrs.) Biva Majumdar, Calcutta.

In the present paper a general mathematical theory is developed to investigate the problem of absorption coefficient in a system of ionized gas, subject to an external electromagnetic field. In the first part the theory is applied to evaluate the opacity coefficient in the interior of stars, the numerical calculations being given for Sun and Capella as well as for the well-known white dwarf, the companion of Sirius B. The second part brings out a further application of the theory to estimate the absorption coefficient of liquid metals which are perhaps akin in some sense to white dwarf stars and a satisfactory agreement with the observed values has been obtained. The results are then, as a whole, discussed in reference to the existing theories of Eddington and others on absorption coefficient in the interior of stars.

33. Can a particle be influenced by its own gravitational field ?

N. R. Sen, Calcutta.

According to the Newtonian theory of gravitation a particle is not influenced by its own gravitational field, and when several bodies are in the field, the motion of the centre of gravity of any one of them is not influenced by the part of the total field which is contributed by that body. This need not be so in Einstein's theory of gravitation. This question is examined for a single isolated particle. The treatment is complicated by certain integrals assuming infinite values. By a suitable limiting process it is possible to arrive at the following definite results which are rigorous and involve no approximation. A particle has *no* tendency to be influenced by its own gravitational field when observed from the rest system or from a system in uniform relative motion with respect to the particle. But when observed from a uniformly accelerated system, its gravitational field at itself will appear to be just of the strength to produce its own acceleration with respect to that system. This is a perfectly self-consistent result pointing to the inner consistency of the Principle of Equivalence with the Geodesic postulate from which the above results have been derived.

Geophysics

34. Graphical computations of energy realizable under certain atmospheric conditions.

C. W. B. Normand, Poona.

The well-known examples of Margules involve lengthy computations. Approximate results can be obtained by simple means on an adiabatic diagram, e.g. on a temperature-entropy diagram. This method can be extended easily to examples of a much more general type than those worked out by Margules. Examples, in which condensation of water vapour takes place, can also be computed graphically and show how great a factor the latent instability of water vapour may be in the development of kinetic energy.

35. Does rain play any part in the replenishment of earth's negative charge ?

S. K. BANERJI, Poona.

At Bombay thunderstorms invariably move overhead in some east-west or west-east direction according as they are 'heat' thunderstorms or 'line-squall' thunderstorms. An analysis has been made of the charge brought down by rain during the passage of 23 thunderstorms over Bombay in the years 1930–32. This shows that the average positive charge per cubic centimetre of rain is 0·11 els. unit and the average negative charge per cubic centimetre of rain is 0·12 els. unit. These two amounts are very nearly equal to each other, but the mean amount of negative rain (namely 1·39 cm.) per thunderstorm is in considerable excess of the mean amount of positive rain (namely 0·97 cm.). The result is that on the average each sq. cm. of ground received 0·17 els. unit of negative charge and 0·11 els. unit of positive charge, and estimating that an area of (100 km.)^2 received charge at this rate, it is concluded that each thunderstorm transferred to the ground $5{\cdot}6\times10^3$ coulombs of negative electricity and $3{\cdot}6\times10^3$ coulombs of positive electricity. The question is, therefore, asked whether, if an analysis is made in this way of the records of charge at other stations in respect of thunderclouds which have definitely travelled overhead, rain would be found to transfer an excess of negative charge to the ground on the average everywhere.

36. Focal depths of earthquakes in India and neighbouring regions.

K. R. RAMANATHAN *and* S. M. MUKHERJEE, Bombay.

1. Methods of determining focal depths of earthquakes; methods available for use in India.
2. Depths of some earthquakes in the Hindu Kush region as determined from seismograms.
3. Depths of some earthquakes in Assam as determined from seismograms; comparison with information obtained from other sources. The conclusion is reached that the depth of the original disturbances of many of the earthquakes in the region of the Khasi and Jaintia Hills are 60 to 80 kms. These deeper shocks are sometimes accompanied by breaks at small depths.
4. Depths of some earthquakes in and off Sumatra.
5. The organization needed for the determination of focal depths and other characteristics of earthquakes.

37. The diurnal variation of magnetic disturbance at Bombay (Alibag).

K. R. RAMANATHAN *and* R. NARAYANASWAMI, Bombay.

The present paper contains an analysis of the irregular magnetic disturbances (apart from magnetic storms) at Bombay and their comparison with similar data obtained in higher latitudes. As an index of disturbance the departures of the ranges of H in each hour from the corresponding mean ranges on the five international quiet days in the month, were used. The irregular disturbance variation is a function of the local time. The data used cover the period of 11 years, 1923–1933.

The main results of the investigation can be summarized as below :—

1. The hour of minimum disturbance occurs early in the morning usually between 4 to 5 or 5 to 6, and that of the maximum near about noon.
2. There is a secondary maximum at about 22 to 23 hrs. at night with an intervening minimum at about 12 to 20 hrs.
3. Analyzing the results according to month, the day maximum is more pronounced in the months April to August. In the winter months, there is a tendency for the variation to approach the European type (Eskadalemuir and Wilhelmshaven) in which there is one minimum in the morning (at about 9 hrs.) and a maximum in the evening (at about 22 hrs.).
4. If days of magnetic character 2 are excluded, the diurnal variations are similar, but the late evening maximum is suppressed leaving the noon maximum more pronounced.

It is generally believed that ' in the latitudes between the two auroral zones, that is, up to at least 65° magnetic latitude, *Di* has a simple daily variation, with its maximum in the evening as the auroral zone is approached the hour of maximum gets later, from about 21 hrs. at 55° to midnight at 70°. Up to this latitude the hour of the daily variation of *Di* does not vary much either with season or with the general intensity of magnetic disturbance ' (Chapman). The present analysis of Bombay data shows that in low magnetic latitudes, the main variation is a maximum near noon with a minimum a little before sunrise. The evening maximum of temperate latitudes is superposed on this simple variation. The probable causes of the variation are discussed.

38. Dust-storms of Agra.

B. N. Sreenivasaiah *and* N. K. Sur, Poona.

After briefly summarizing characteristics of 152 dust-storms which occurred at Agra between 1924 and 1930, the atmospheric structure associated with dust-storms over Agra, as revealed by certain special meteorograph ascents made by one of the authors (B. N. Sreenivasaiah) and by some other records obtained at Agra, is discussed with particular reference to the conditions of latent instability. The general conclusion which the study points to is that the existence of latent instability is a necessary condition for the occurrence of a dust-storm but is not sufficient by itself to start the phenomenon unless there is a trigger. Insolation and undercutting by cold winds, associated with cold fronts or otherwise, are seen to be suitable agencies to act as triggers to start dust-storms at Agra. The aid is taken of trajectories of air currents and synoptic weather charts to determine the trigger action and also to explain the existence of latent instability. Further study is in progress to test these provisional conclusions.

39. Foreshadowing formula for monsoon rainfall in Upper Siam.

V. Doraiswamy Iyer, Poona.

The formula for foreshadowing the rainfall of Upper Siam obtained with data up to 1926 is tested for its performance in the ten years, 1927 to 1936. Two of the factors included in the formula which showed poor performance are replaced by two other factors which showed a more consistent performance in the last ten years, and a new formula for foreshadowing is obtained with a joint correlation coefficient $R = 0{\cdot}71$.

40. Average intensity of rainfall on a rainy day in India.

V. Doraiswamy Iyer *and* Kasturinath Sobti, Poona.

Monthly charts of the average intensity of rainfall on a rainy day are prepared and discussed. The average intensity associated with winter disturbances is found to be moderate. The intensity increases gradually during the hot weather till a maximum value is reached in the monsoon. During the height of the monsoon the chief feature of the distribution is the contrast between the windward and leeward sides of the mountain ranges. In the retreating monsoon months the area of highest intensity lies along the coast of the Bay of Bengal.

41. Distribution of heavy rainfall over India.

V. Doraiswamy Iyer *and* Mohammad Zafar, Poona.

Two charts showing the distribution over India of heavy falls exceeding 3″ and 5″ in 24 hours are given and briefly discussed. A chart showing the heaviest fall that has occurred in different parts of India is given followed by twelve monthly charts showing the distribution of the heaviest fall in each month. Their chief features are briefly explained.

42. Influence of cloudiness on radiation received on a horizontal surface from the sun and sun-lit sky.

P. K. Raman, Poona.

The paper gives a summary of the mean monthly values of $S+H$ (radiation from the sun and the sky) for 1935 as measured on a Kipp and Zonen recording solarigraph under varying conditions of the sky. The mean duration of sunshine is also given for each month. The mean hourly and seasonal variation of intensity of radiation is discussed. After Angstrom and Kimball, the solar radiation values are expressed as a linear function of the ratio of actual to possible duration of sunshine. A few typical charts on cloudy days are reproduced. The radiation on days with skies overcast with different kinds of clouds is discussed in relation to the radiation from clear skies.

43. Distribution of gases in the upper atmosphere.

S. K. Mitra *and* H. Rakshit, Calcutta.

A problem of great importance in the study of the upper atmosphere is the estimation of the height at which diffusive equilibrium under the action of gravity begins to be important. Investigations by Maris and by Epstein show that equilibrium sets in rapidly in regions of low pressure. The question as to the level from which diffusive equilibrium will begin to be important can be settled by observations on the disturbing causes. This level should commence from the height at which the time taken for appreciable separation of the constituents is small compared with the period of the disturbance. From a consideration of disturbing winds which are known to exist at levels of 70 to 100 km. the lower limit of the height of diffusive equilibrium level may be taken as 100 km.

The upper limit is calculated after Epstein for two atmospheres, one consisting of N_2 and O_2 and the other of N_2 and O taking into consideration the disturbing effect due to heating and cooling. It is found that the mixing should extend up to heights of 500 km. and 350 km. respectively.

Calculations are also made of the pressures at and the masses of the two constituents existing above different levels in the upper atmosphere. The values of both of these are higher than those obtained by previous workers.

Dielectric Constants, Ionization, Radio Waves and Scattering

44. Lecture on 'The dielectric constants of solid bodies'.

PROF. C. G. DARWIN, Cambridge.

45. Dielectric constant of ionized gases.

S. GANGOPADHYAYA *and* S. R. KHASTGIR, Dacca.

Measurements of the dielectric constant of ionized air and nitrogen have been made for ultra-high frequencies using condenser plates placed outside the discharge tube. It has been found that the value of the dielectric constant which is less than unity decreases approximately proportionately with the increase of the tube current only up to a certain value of the latter. Beyond this value the dielectric constant gradually attains the value of unity and subsequently becomes greater than one for larger tube currents. The results of our experiments have been explained as due to the formation of ionic sheaths round the inside surface of the discharge tube. By eliminating the ionic sheath formation by using an earthed cylindrical copper anode (with slits) surrounding the inside of an air discharge tube and an aluminium cathode in the shape of a straight rod along the axis of the copper cylinder, it has been found that the dielectric constant of ionized air is always less than one. An irregularity in the curve showing the values of the dielectric constant of ionized air for different ionization values still remains after the elimination of the sheath effect. It has been shown that this is not connected with Tonks and Langmuir's plasma electronic oscillations. The irregularity can perhaps be explained as due to the effect of conductivity acquired by the ionized medium.

When wavelength has been changed keeping the tube current constant, the dielectric constant of the ionized air has been found to decrease almost proportionately with the square of the wavelength up to a certain wavelength, thus showing agreement with the Eccles-Larmor formula up to that point. Beyond this wavelength the dielectric constant has been found to increase. These results are similar to those of experiments of Khastgir and A. Imam using a different method. It has been shown that turning point in the dielectric constant curve is not due to effect of plasma electronic resonance. Further experiments are necessary to elucidate the problem.

46. The ground-attenuation of ultra-short waves along the earth.

M. K. CHAKRAVARTY *and* S. R. KHASTGIR, Dacca.

Relative field-strengths have been measured at different distances along a straight line in an open ground from a portable ultra-short wave transmitter fitted with a quarter wave aerial. The transmitter has been of sufficient power to enable field-strength measurements to be carried out with accuracy up to a distance of 50 m. from the transmitter. A wavelength of 3·64 m. has been employed for the purpose. The receiver used has been a heterodyne receiver with an oscillator-detector circuit followed by L.F. power amplification. The L.F. alternating voltage developed across the telephones in the output circuit when the transmitter is on has been measured by a sensitive valve-voltmeter constructed for the purpose. Before any attenuation measurement has been made the frequency of the beat-note has been adjusted to a definite value with the help of an adjustable Galton whistle which has been compared with the continuous heterodyne whistle obtained in the loudspeaker connected with an L.F. amplifier. All measurements have been made through telescopes situated at some distance.

Leaving aside only one observation for the 40 m. site which has been close to a tree, the attenuation measurements have been examined in the light of Norton's formula for ground attenuation of radio waves from a short antenna. Recognizing that some discrepancy at near distances would occur between theory and experiment due to the finite height of the aerial and the interference effect as suggested by Smith-Rose and McPetrie, attenuation curves have been computed according to Norton for suitable values of the electrical constants of the soil. The values of the electrical conductivity σ and the dielectric constant ϵ of the ground which give agreement with Norton's formula are :

$$\epsilon = 7 \text{ e.s.u.}$$

$$\sigma = {\cdot}91 \times 10^{-14} \text{ e.m.u.}$$

The values for wet ground have been however larger, viz. :

$$\epsilon = 10 \text{ e.s.u.}$$

$$\sigma = 1{\cdot}84 \times 10^{-14} \text{ e.m.u.}$$

It is significant that these values agreed in their orders of magnitude with the values obtained by the direct laboratory method.

47. Direct determination of the electrical constants of soil at ultra-high radio-frequency.

M. K. Chakravarty *and* S. R. Khastgir, Dacca.

In the present investigation the attenuation of ultra-short waves travelling along a Lecher wire system immersed in a specimen of Dacca soil from the first potential node has been determined for a certain range of ultra-high frequencies and for varying moisture-contents.

The theory of measurements consists in evaluating the electrical conductivity σ and the dielectric constant ϵ of soil from the formulæ :

$$\epsilon = \left(\frac{\lambda_a}{\lambda_s}\right)^2 - \frac{\alpha^2\lambda_a{}^2}{4\pi^2}$$

$$\text{and } \sigma = \frac{\alpha w \lambda_a{}^2}{4\pi^2\lambda_s}\,.$$

After having measured λ_a and λ_s, α is determined from the 'high-width' of the resonance curve.

The value of the dielectric constant of the specimen of the soil has varied from 3·95 (e.s.u.) at a moisture-content of 7·2% to a value of 29·4 (e.s.u.) at a moisture-content of 30·2%. The value of the electrical conductivity is of the order of 10^{-14} e.m.u. It has increased with the increase of moisture-content.

The value of the electrical conductivity has been found first to increase and subsequently to diminish with the increase of frequency. The range of frequencies has been from 73 to 89 megacycles/sec. The dielectric constant has been found to diminish with the rise of frequency.

It is to be noted that the values of ϵ and σ of the particular specimen of Dacca soil agree in their orders of magnitude with the values estimated from the attenuation measurements.

48. On Pannekoek's theory of the upper atmospheric ionization.

M. N. Saha, Allahabad.

In 1926, Prof. Pannekoek of Amsterdam, proceeding from the present author's theory of thermal ionization, proved that the Upper Atmospheric Ionization (Ionosphere) can be explained as the result of photoelectric action of sunlight on the gases of the atmosphere. In the present paper, this theory as well as its extension by S. Chapman is critically examined, and is shown to be capable of various improvements. But it is pointed out that a complete solution cannot be obtained unless the spectra of N_2 and O_2 are thoroughly investigated in the far Schumann region with a view to obtaining information about photo-ionization of these molecules and atoms. It is shown that the mathematical expression for the process of photo-ionization is widely different from that assumed by Pannekoek (based on Kramer's theory), but the solution of the problem presents mathematical difficulties which have not yet been overcome. Besides, it is pointed out that Pannekoek's considerations do not apply strictly to an atmosphere possessing a temperature gradient.

Making certain plausible assumptions, it is shown that the formation of different layers can be attributed to the following physical processes :

1. F_2-layer—it is probably due to the complete dissociation of O_2 into atomic oxygen during hours of sunlight by the rays of the sun, and subsequent ionization of the O atoms.
2. F_1-layer—its formation may be ascribed to the photo-ionization of O_2 to O_2^+ and N_2 to N_2^+ according to processes which involve the second ionization potential of these molecules.
3. E-layer—its formation may be ascribed to the photo-ionization of N_2 to N_2^+ and O_2 to O_2^+ according to a process which involves the first ionization potential of these molecules.

49. On the propagation of electromagnetic waves through the atmosphere.

M. N. Saha, R. N. Rai, *and* K. B. Mathur, Allahabad.

In this paper, the equations for propagation of electromagnetic waves in the Earth's Atmosphere are obtained from fundamental considerations, both when damping is present and when it is negligible. The equations are solved for vertical propagation in the case when the complex dielectric constant is regarded as constant. The results obtained in this case are identical with those of Appleton and Hartree, for reflection of the waves and for their polarization, but when the variation of refractive index is taken into account, considerably divergent results are obtained some of which have already been reported by one of the authors (R. N. Rai). It is pointed out that if the equations can be rigorously solved, much new result may be expected.

50. Ionization of F-region before sunrise.

K. B. Mathur, Allahabad.

Curves have been drawn for the time of sunrise and sunset at different heights for Allahabad for the whole year and with the help of these curves, the height where the sun's rays are falling at the time of minimum ionization of the F-region just before sunrise is found. Similar calculations have been made for Washington and Slough and from these it has been shown that this height is greater in winter and smaller in summer for all the latitudes. For higher latitudes (e.g. Slough) the ionization always begins to rise after sunrise in the F-region while for lower latitudes (e.g. Washington and Allahabad) we can roughly say that the ionization begins to rise before sunrise in winter and after sunrise in summer.

51. On an exact test of association between the occurrence of a thunderstorm and an abnormal ionization.

S. S. Bose *and* P. C. Mahalanobis, Calcutta.

In testing independence with 2×2 tables, if the frequencies are small $P\chi^2$ test, in general, gives underestimated probabilities. If the distribution is not very skew, Yates correction for continuity gives good approximation. If it is skew, it is always desirable to perform the exact test by the hypergeometric series.

The observations show that a significant association exists between the occurrence of a thunderstorm and an abnormal ionization in the upper air, that the association between magnetic disturbance and abnormal ionization or between magnetic disturbance and thunderstorm is not appreciable.

52. Raman effect at low temperature: solid toluene and solid ethylene dichloride.

S. C. SIRKAR *and* J. GUPTA, Calcutta.

The Raman spectra of solid toluene and solid ethylene dichloride have been studied at about −190°C. It has been observed that in the former case there is no new Raman line of appreciable intensity in the neighbourhood of the Rayleigh line and in the latter case there is a strong new line with $\Delta\nu$ equal to about 58 cm.$^{-1}$ and another new broad band at about 98 cm.$^{-1}$ The Raman spectrum observed in the latter case corresponds to that due to the *trans* configuration as observed by Mizushima and others at the temperature of solid carbon dioxide, but with the difference that the two new lines mentioned above were not observed by the said authors and that some of the lines are shifted considerably at the lower temperature. Since toluene molecule has no centre of symmetry, there is a greater chance of the occurrence of an asymmetric restoring force during lattice oscillation in solid toluene than in the case of centro-symmetrical molecules and as has been proved by the investigations by Menzies and Mills of the Raman spectra of ammonium chloride and ammonium bromide at low temperature, the Raman line due to lattice oscillation in solid toluene ought to have been more intense than those in the case of other centro-symmetrical molecules. Since the observed facts are contrary to these expectations, the new lines close to the Rayleigh line may not be due to lattice oscillation but may be due to intermolecular oscillation in polymerised groups as suggested previously.

53. Effect of high temperature on the Raman spectra of substances.

R. ANANTHAKRISHNAN, Poona.

Placzek's polarisability theory of the Raman effect indicates: (1) that the absolute intensities of *both* the Stokes and the anti-Stokes Raman lines increase exponentially with temperature, and (2) that the ratio of these two intensities tends to approach more and more towards unity at higher temperatures. While theory and experiment have been found to be in fair agreement in respect of (2), considerable discrepancies have been observed in respect of (1). Instead of the expected increase in the intensity of the Stokes lines with rise of temperature, a pronounced diminution in their intensity has been generally noticed. A discussion of these points and an account of some preliminary results obtained in the case of liquid carbon-tetrachloride are presented.

54. On the moving boundary method for the determination of absolute rates of migration and transport numbers of ions, and a verification of the theory of Kohlrausch and Weber.

N. C. SEN GUPTA, Calcutta.

The influence of the concentration of indicator solution on the velocity and transport numbers of the leading ion has been measured with rising boundaries in the case of KCl, KNO_3 and K_2SO_4 in centinormal solutions using potassium iodoeosinate as the indicator electrolyte in different concentrations. It has been found that when the concentration of the indicator is greater than that demanded by the equation of Kohlrausch and Weber the transport number of the leading ion is practically constant being

$$T^{KCl}_{Cl} = 0{\cdot}503\,; \quad T^{KNO_3}_{NO_3} = 0{\cdot}485\,; \quad T^{K_2SO_4}_{SO_4} = 0{\cdot}511$$

within the range of experimental errors, i.e. about $\pm 0{\cdot}3$ p.c. When the indicator solution is initially too dilute the results are vitiated. The adjusted concentration of the indicator ion behind a boundary has been measured potentiometrically with potassium picrate as the indicator and 0·02N. KCl as the leading solution. It has been found that from a more concentrated solution a solution of KPic comes out at a concentration of 0·0120N. The transport number and absolute velocity of picrate ion at 35° have been found to be 0·301 and $35{\cdot}4 \times 10^{-5}$ cm./sec. respectively.

55. The electron affinity of the halogens.

B. N. Srivastava *and* A. N. Tandon, Allahabad.

The electron affinities of chlorine, bromine and iodine have been recalculated from the experimental measurements of Prof. Saha and Tandon published earlier by taking into account the contribution of the vibrational terms in the equation of dissociation equilibria. The dissociation temperature has been found by experimentally comparing the temperature inside the graphite tube with that of the outer surface as recorded by the pyrometer under the same experimental conditions. These new values have been used in the present calculations. The values of the electron affinity thus obtained are in good agreement with the values obtained by other workers, and are as follows :—

Chlorine 85·4 K. cal. ; Bromine 79·5 K. cal.; Iodine 72·4 K. cal.

56. On the theory of semiconductors in magnetic field.

M. Sen Gupta, Sibpur.

In the present paper a general mathematical formulation for the change of resistance of semiconductors in magnetic field (both weak and strong) is derived on the assumption of Lorentz force acting on the metal electron. The numerical calculations are given for both deformable (Bloch) and rigid (Nordheim) ionic model of lattice and a general conclusion is drawn of the correctness of Bloch's model. A critical discussion of the results so obtained is made particularly with reference to the validity of Harding's results, and the difficulties to arrive at a quantitative agreement with the observed fact are cited. Hall's constant is evaluated in both the cases of strong and weak magnetic field in Bloch's model.

57. The theory of molecular dissociation in upper atmospheres.

R. C. Mujumdar, Calcutta.

A preliminary theoretical attempt is made in the present paper to estimate the degree of molecular dissociation at different heights in upper atmosphere under the action of the ultra-violet light of the sun. It is found, as for example, that the oxygen molecules are completely dissociated at a height above the *E*-region of the Ionosphere, provided we assume a temperature of 300°K and a pressure corresponding to the average mass of oxygen and nitrogen molecules. In the light of the results obtained a critical discussion is given as to the mechanism of absorption of sun's ultra-violet radiation by the molecules present in the upper atmosphere.

58. Stratification of the ionosphere.

J. N. Bhar, Calcutta.

Calculations of atmospheric ionization are made after Pannekoek with certain modifications as to the details in the light of our present knowledge regarding the mechanism of ionization of the constituents and the distribution of same in the upper atmosphere.

It is found that if the sun is regarded as a black body at 6800°K two ionized layers are formed at the levels at which the partial pressures of atomic oxygen and molecular nitrogen are 10^{-4} and 10^{-3} dynes/cm.^{2} respectively. The maximum ionic densities are found to be 8×10^6 and 2×10^5 electrons per cm.^{3} nearly.

If the results of Mitra and Rakshit on the distribution of pressure with height in the upper atmosphere are used it is found that the regions of maximum ionization referred to above occur at the levels of 350 and 270 kms. nearly. These layers, though their heights are a little greater than those usually accepted, may be reasonably identified with the F_2 and F_1 regions of the ionosphere.

It is also shown that in the present state of our knowledge it is not possible to account for the existence of ionized layers much below 200 kms. on the assumption of the sun radiating like a black body at 6800°K.

General and Applied Physics

59. Lecture on 'The method of systematic relaxation of constraints, a general method of attack on the equations of mathematical physics'.

Prof. R. V. Southwell, Oxford.

60. Studies on the spreading of certain substances on a clean surface of water.

L. A. Ramdas *and* P. S. Vaidyanathan, Nagpur.

The paper describes a series of experiments on the spreading of mono-molecular films on a clean surface of water. It is shown that the rate of spreading from the edges of a piece of camphor floating on water, depends only on the perimeter of the edge where it is in contact with water. The area of the water surface and the depth of the layer of water below have no influence on the rate of surface solution from the parent material. The rates of surface solution, and of solution in the ordinary way by diffusion from the material kept inside water, have been studied quantitatively. The former is very much more rapid than the latter. It is shown that, during the process of spreading on water, the adjacent layers of water are also dragged along, and that the film dips into the water below at the periphery of the spread area. These movements agitate the liquid column below. On illuminating the column suitably the convection can be seen from the movements of suspended particles. The fact that the spreading of a mono-molecular film on water is accompanied by vigorous convection in the water column below has been over-looked in previous work on the subject.

61. Study of instability in layers of fluids when the lower surface is heated.

S. L. Malurkar, Agra.

Rayleigh and Jeffreys have discussed the theory to determine the maximum temperature difference that could be maintained between two layers of fluid sheets before instability started. Brunt and Low applied Rayleigh's criterion to explain the high lapse-rates near the ground. The measurements by the author and Ramdas showed, however, that very much larger lapse-rates could exist very near the ground on sunny afternoons than given by the above theory. A theory was advanced to account for the distribution of temperature near the ground taking account of radiation from successive layers. Without considering whether the temperature difference that existed between two given heights was at all possible, the actual value obtained from experiment was used as a boundary condition to derive the distribution of temperature with height. But the complete problem could be divided up into two distinct parts which can be dealt separately :—

1. Nature of temperature—height curve for a given temperature difference.
2. Maximum temperature difference that is possible in a given height interval for a given temperature distribution.

Rayleigh and Jeffreys assumed that the temperature height curve was linear. The equations used by them under steady conditions is only capable of dealing with the above linear lapse-rate. In actual practice the temperature height curve near the ground is concave upwards and resembles a hyperbolic sine curve. The problem is therefore to be dealt with from first principles so that in steady conditions the equations give nearly the observed curve. The fundamental equation of the paper is

$$(d^2/d\xi^2-a^2)^2 \operatorname{sech} \gamma\xi(d^2/d\xi^2-b^2)\chi = -\lambda a^2\pi\gamma \operatorname{cosech} \pi\gamma\chi.$$

The equation had to be solved by a new method in order to give interpretable results. The method is briefly explained. Both the problems of Rayleigh and Jeffreys are considered and results obtained suitable for computation. With Rayleigh's boundary condition the first approximation is

$$\beta g\rho c_p h^4/k\nu\theta_0\pi^4 = \frac{(1+a^2)^3}{a^2}\left\{1+(5+a^2)\gamma^2/4(1+a^2)\right\},$$

where ρ is the density, c_p the specific heat at constant pressure, β is the mean lapse-rate in a given height interval h, θ_0 the initial temperature, k, ν the coefficients of conductivity and viscosity of air, γ a constant which is a measure of the concavity of the hyperbolic sine curve, and a is a constant. In Rayleigh's original problem the right side of the equation would merely be $(1+a^2)^3/a^2$ with $a^2 = \frac{1}{2}$ which is equal to $\frac{27}{4}$ under the conditions of the problem. Near the surface of the ground γ is about 1 or 2 and we need higher approximations to get at the correct value. This can be done easily with the expressions given in the paper.

It is deduced that the maximum difference of temperature that can be maintained between two given heights is dependent on the distribution of temperature with height. Under the various usual boundary conditions the temperature difference that can be maintained when the distribution curve is concave upwards is greater than if it is linear.

62. Some plane stress problems of non-isotropic materials.

BIBHUTIBHUSAN SEN, Calcutta.

In this paper an attempt has been made to solve two problems connected with homogeneous æolotropic material having three orthogonal planes of symmetry. The first problem considered is that of a thin circular disk rotating about a normal axis passing through its centre, and the second problem deals with the bending of a uniformly loaded beam of narrow rectangular cross section, the material in each case possessing æolotropy of the type stated above.

63. On the theory of liquids.

A. Ganguli, Chandernagore.

Energetics of the liquid state have been critically discussed and introducing interaction forces statistical methods have been applied for the study of structure and properties of liquids. It is suggested that liquid molecules under high internal pressure do not obey the classical statistics and incipient degeneracy sets in. By the application of van der Waal's theory of imperfect gases simple expressions for the viscosity and diffusion of liquids have been derived.

64. Variation in fibre strength and fibre weight per inch with the group length of fibres in Indian cottons.

C. Nanjundayya *and* N. Ahmad, Bombay.

The breaking load of single cotton hairs of different lengths has been determined with a Balls Magazine Hair Tester, after making some necessary modifications. The following conclusions are drawn from the results :—

(1) The mean breaking load decreases with increase in group-length.
(2) The frequency distribution for each group-length is asymmetrical and skew.
(3) The correlation coefficient between group-length and mean breaking load of the group is just significant and a hyperbolic equation fits the length mean breaking load curve.
(4) General relations are deduced from which the mean breaking load corresponding to a group-length can be deduced either from the mean length or the mean breaking load of a cotton.

The weight per unit length of each group-length was also determined. It is found that (1) the weight per unit length decreases with the increase in group-length, (2) the conclusions of the previous workers regarding the variation of fibre weight per inch of different cottons when classified into botanical species are confirmed by the present experiments.

It is further found that the intrinsic strength shows a mild tendency to decrease with the increase in length. The correlation coefficient between mean fibre strength and mean fibre weight per unit length, obtained by pooling together all values irrespective of cotton, is high and indicates that 50–70% of the variation in fibre strength is accounted for by the fibre weight per unit length, while the remainder may be due to the occurrence of bruises, cracks, pits, etc. on the fibre surface.

65. The effect of twist on the strength and length of cotton fibre.

Harirao Navkal *and* Nazir Ahmad, Bombay.

The fibre strength and the percentage contraction of five cottons have been measured with the fibre in the natural state and after inserting 25, 50 and 100 turns respectively in either direction. The following conclusions are drawn :—

(1) In general, the fibre strength first increases, reaches a maximum and then falls as the twist is gradually increased. The maximum is attained at lower twists by the shorter varieties.

(2) The left-handed twist causes a slightly higher increase in strength than the right-handed twist.

(3) The fibres contract on being twisted, the percentage contraction increases rapidly with twist and is greater for the shorter than for the longer cottons.

(4) The variability of strength and length and the skewness of the strength frequency curves are all significantly higher at 100 turns per

inch than at zero twist, the direction making no difference to the magnitude of these effects.

(5) On the whole, the amount of twist usually employed in the spinning process improves the fibre properties but this improvement is very small and can account for only a minute fraction of the increase in yarn strength resulting from the insertion of twist.

(6) The adverse effects of twist on the properties of fibre are somewhat more marked for the shorter than for the longer cottons.

(7) The molecular chain theory of structure of the fibre is capable of explaining, in a qualitative way the principal effects of twist noticed in the course of this work.

66. A device for determining the proportion of fibres of different length in a sample of cotton.

N. AHMAD *and* C. NANJUNDAYYA, Bombay.

The Cotton Stapling Apparatus, designed at the Technological Laboratory (Bombay) some time ago, gives the mean length and weight per unit length of a cotton. It, however, suffers from the limitation that it does not give the frequency distribution of length, a knowledge of which is often useful not only to the research worker but also to the trade and industry. With a view to remedying this deficiency, a new attachment to the Stapling Apparatus has now been designed. The description and mode of operation of this device are given in this paper. Further, the results of experiments, conducted with a view to determining the degree of agreement with the other instruments in vogue, are also given. It i shown that this device is capable of yielding consistent results which agree well with those given by other methods.

67. The clinging power of cotton in relation to its other physical properties.

K. R. SEN *and* N. AHMAD, Bombay.

The clinging power for seventeen different cottons was determined at two different inclinations of the slipping fibre with an apparatus specially designed for this purpose which eliminated most of the sources of error occurring in the work of the previous authors. The effects on clinging power of exerting different pressures and of mercerization without tension were also studied. The following are the main conclusions drawn from the results :—

(1) The effect of convolutions on clinging power is greatly disturbed by the irregularities in the distribution of the former ; so much so that a *negative trend* in the relation between the two characters may exist.

(2) Coarse cottons usually possess a rough surface. For extremely coarse cottons roughness increases more rapidly than coarseness. For very fine cottons, on the other hand, the change in roughness is slow.

(3) As the surface roughness increases the amount of wax *per unit surface* increases at first, but ultimately reaches a steady value. These phenomena are fully explained by consideration of relative rates of change of the different characters involved.

(4) Clinging power tends to decrease as the relative humidity increases. Decrease of temperature also appears to reduce the clinging power, although to a considerably smaller extent.

(5) At low pressures the coefficient of friction between cotton fibres ordinarily decreases as the pressure is increased. This is ascribed to the differences in contact between the fibre surfaces. Maximum possible contact occurs for different cottons at different pressures, the critical pressure lying between 5 and 6 cms. of mercury.

(6) Mercerization without tension reduces the clinging power of fibres mainly through removal of convolutions and to some extent as a result of

smoothening out corrugations or crinkles. For inclined fibres reduction in clinging power appears to result mainly from decrease in surface crinkles.

(7) Finally, the bearing of the results on irregularity in a yarn has been discussed.

68. Generalized theory of the Schrage motor.

J. J. Rudra, Madras.

In a previous paper (R.G.E., 1934, Vol. 35, p. 843,) the author has given the exact and approximate theories of the Schrage motor for the cases when the axes of the commutator brushes and the secondary are coincident ($\beta = 0$) and when they are in opposition ($\beta = \pi$). In the present paper the theory of the motor for any value of β has been worked out by a method different to that used in the previous paper. It is shown how the complete performance curves of the motor may be predetermined with the help of data obtained from no load tests on the motor. The performance curves predetermined in this manner are compared with test curves of two motors. An analysis of the motor has been made which shows that the slip voltage, in phase and quadrature components of the commutator winding, and the current in the commutator winding make definite contributions of power and the sum of these gives the total power developed by the motor.

69. Modifications in Leblanc phase advancer.

J. J. Rudra, Madras.

This paper suggests modifications of Leblanc phase advancer with a view to improve its range. The simplest modification is obtained by replacing the single brush set in the advancer by brushes connected together through racks and pinion arrangement. By dividing the secondary of the motor in three sections and connecting each section to a pair of advancer brushes compensation of the motor can be varied by turning the pinion.

The second modification is to provide the phase advancer with a stator containing a three-phase winding. By connecting the stator winding to a three-phase rheostat, compensation provided by the phase advancer can be varied within wide limits by changing the resistance in the stator circuit.

The third modification is to provide a three-phase winding below the commutator winding and connect the former through its slip rings to a three-phase rheostat. Compensation can be varied within wide limits by changing the resistance in the rotor circuit.

A fourth modification is a combination of the second and the third.

Tests with the second, third and fourth modifications have been carried out and the second is found to give the best results. A theory of the phase advancer having the second or third modification is under consideration.

70. The theory and performance of the Torda motor.

A. R. Ramanathan *and* J. J. Rudra, Madras.

Prof. Cramp has given an approximate theory of this motor (J.I.E.E., 1929, p. 756) indicating the rough limits between which the current locus of the motor lies and the complications introduced in the theory owing to the variables of the commutator winding. In this paper the authors propose a theory of the motor which, taking into account all the variables of the commutator winding, enables the complete current locus and performance curves to be predetermined. The current locus and performance curves of a 20 h.p. motor determined according to this theory are compared with test results of this motor given in Prof. Cramp's paper. The predetermined and experimental current loci agree very well. The predetermined performance curves of the current, power factor, speed and efficiency against brake horse power agree fairly well with test results except in the case of efficiency. A probable cause of this disagreement is the increase in iron losses due to distortion of the main flux of the motor by super-imposition of the commutator winding flux on it.

71. Stator-fed variable speed shunt polyphase commutator motors.

A. Srinivasan, Madras.

Speed of the stator-fed commutator motor is varied by injecting a voltage from (*a*) a transformer with tappings, (*b*) an auxiliary winding with tappings on the stator of the motor, and (*c*) auxiliary winding on the stator of the motor and a transformer in the form of an induction regulator. This paper contains results of tests carried out to study the difference in the characteristics of motors of the three types.

72. Some economic considerations in the choice of electric lamps.

D. R. Bhawalkar *and* G. D. Joglekar, Calcutta.

Curves are drawn for a typical case of lighting having an average luminous output of 10,000 lumens for 1,000 hours, showing the relation between the total expenses, initial cost of the lamps, the average efficiency throughout life of the lamps, the average life of lamps and the charge per unit of electricity. The electricity charges are those usually found in India. Curves for any other particular problem can be similarly drawn and made use of in selecting lamps, whose total running cost would be the cheapest. The initial cost of lamps forms an important part of the total expenses when the rate for electricity is low, but at higher rates, it becomes insignificant. More attention should be paid to the efficiency of the lamps at higher rates for electricity.

73. An experimental dry cell.

G. D. Joglekar *and* L. C. Verman, Calcutta.

No less than thirty variables enter into the manufacturing processes involved in the making of dry cells, and each one of these exerts a significant effect on the ultimate properties of the cells, such as its initial electrical characteristics, shelf life, output capacity, etc. Initial characteristics indicate *in general* the behaviour of a cell in subsequent life.

In order to facilitate the study of the effects of manufacturing variables on the initial characteristics, an apparatus has been designed by the help of which it is possible to determine the e.m.f., internal resistance, polarization, etc., as affected by a number of variables, such as the composition of depolarizer, electrolyte, dolly forming pressure, etc. By the use of this so-called experimental dry cell, a considerable saving of time is effected in determining the characteristics of various raw materials, since it avoids the necessity of having to make cells and subjecting them to regular tests.

Mathematics and Statistics

74. Geometry of intersections.

F. W. Levi, Calcutta.

The investigations of the intersection-theorems of the projective Geometry inaugurated by the classical papers of David Hilbert have been continued by Blaschke, Thomson, Reidemeister, Ruth Moufang and others. They found a close connection between the intersection theorems and the theories of groups and of generalized fields (skew fields, alternative systems). Starting with a genêral investigation of all geometries satisfying the projective axioms, we follow a path similar to that in the foundation of the theory of groups by ' free groups ' and ' relations '. There exists a ' free geometry ' to which every geometry is homomorphic. Every axiom of intersection furnishes a ' relation '. While the topological equivalent of a relation in the theory of groups is a circuit, a relation in the geometry of intersections is represented by a tree. The paper deals with different propositions in ' free geometry ' and in ' geometries with relations '.

75. On the theory of a non-linear partial differential equation of the elliptic-parabolic type.

M. Raziuddin Siddiqi, Hyderabad, Deccan.

The occurrence of non-linear differential equations in modern physical theories is making it imperative that such equations should be studied systematically. In several recent papers the author has developed Fourier methods for the unique solution of general non-linear equations of the parabolic and hyperbolic types.

In this paper the method is extended to the non-linear partial differential equation of the elliptic-parabolic type :

$$\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}-\frac{\partial u}{\partial t}=u^2,$$

in the domain $0\leqslant x\leqslant\pi$, $0\leqslant y\leqslant\pi$, $0\leqslant t<\infty$, satisfying the boundary conditions :

$$u(0, y\,;\, t)=u(\pi, y\,;\, t)=0\,;\quad u(x, 0\,;\, t)=u(x, \pi\,;\, t)=0,$$

$$u(x, y\,;\, 0)=f(x, y)=\sum_{m, n} C_{m, n}\sin mx\sin ny.$$

On the assumption that

$$\sum_{m, n}\mid C_{m, n}\mid (m^2+n^2)=C,$$

it is proved that one and only one regular solution exists which can be expressed in the form of a double series :

$$u(x, y\,;\, t)=\sum_{m, n} v_{m, n}(t)\sin mx\sin ny.$$

The coefficients $v_{m, n}(t)$ are determined with the help of a doubly infinite system of non-linear integral equations which is solved by the method of successive approximations.

76. On a principle of duality in circle, sphere and line geometries.

A. Narasinga Rao, Annamalainagar.

Let there be two sets of points (x), (y) in an n-dimensional space S_n with a quadric $\Omega\equiv\sum\limits_{i,j} a_{ij}x_iy_j=0\ (i, j=0,\ 1,\ldots n)$ and suppose there are certain conjugacy relations $\sum a_{ij}x_iy_j=0$ between point pairs one belonging to each set. By subjecting all the points of one set (x) to an arbitrary collineation C and those of the other set (y) to the associated collineation PCP where P is the polarity defined by Ω we get two new sets in which the conjugacy relations with respect to Ω are still preserved. Since circles, spheres and linear complexes may be represented by points in S_3, S_4, and S_5 with a quadric Ω, we may infer from the existence of any configuration that of a dual configuration usually of a more general type.

The principle is applied to obtain generalizations of the Miquel-Clifford theorems in circle geometry, of Schläfli's Double-Six, and of certain configurations in the geometry of oriented circles and spheres in S_n.

77. Through a railway window.

A. Narasinga Rao, Annamalainagar.

The object of this note is to obtain a mathematical description of the apparent deformation which any pattern of the landscape appears to be continuously subject to as seen by a moving observer. Since the visual separation of two objects is proportional to the angle between their directions of vision, the apparent shape of any figure may be represented by its image on the surface of a unit sphere at eye level by central projection. We have thus a streaming of the image points on the visual sphere which is completely characterized by the two statements: (i) that geodesic (great circle) arcs are deformed into geodesic arcs, and (ii) that any geodesic triangle is always in perspective with itself in any of its positions, that is, the join of corresponding vertices are concurrent at a pair of diametrically opposite points while the corresponding sides meet on a fixed geodesic. The divergence and the curl of the stream field on the spherical surface are calculated and interpreted.

78. Parallelism and curvature in Riemannian space.

R. N. Sen, Calcutta.

The paper deals with parallel transport of a vector, the parallelism supposed to be commutative. The Riemannian curvature at a point, which is usually expressed in terms of the Levi-Civita parallelism, has been expressed in terms of a given parallelism.

79. On the reciprocal linear complexes of the system of linear complexes obtained from two quaternary quadrics associated with two linear complexes.

N. Chatterji *and* P. N. Das Gupta, Calcutta.

Weitzenböck has considered the invariants and covariants of a quaternary system of a linear complex and a quadric (' Zum System eines linearen Komplexes und einer Flache zweiter Ordnung,' Journal für Math., **137** (1910), 65–82). From the view-point of a Prepared System Turnbull has discussed the concomitants of a system of n linear complexes (Proc. Lond. Math. Soc., Ser. 2, 25, Parts 4 and 5). The authors (Bull. Cal. Math. Soc., Vol. XXVII, Nos. 3 and 4) have discussed the irreducible system of invariants and covariants of two Quaternary Quadrics associated with two linear complexes. In the present paper the reciprocal lines of the linear complexes obtained in the irreducible list there given with reference to the basic quadric have been obtained and their associated geometry has been indicated.

80. On some properties of G-derivative of a function and its relation to the Logarithmic Chord.

S. MITRA *and* D. N. SEN, Patna.

Taking

$$G(x,\,\alpha) \equiv \frac{(x+\alpha)F(x+2\alpha)+(x-\alpha)F(x-2\alpha)-2xF(x)}{4\alpha^2},$$

its upper and lower limits of indetermination as $\alpha \to 0$ are $G^*\{F(x)\}$ and $G_*\{F(x)\}$, and if these are equal the common value is the G-derivative $G\{F(x)\}$.

The Logarithmic chord of $y = F(x)$ in $(a,\, b)$ is defined by

$$y = \phi(x) \equiv A \log x + B,$$

where $\phi(a) = F(a)$ and $\phi(b) = F(b)$.

Some properties of the derivates are first established. Relations connecting $F(x)$ with $\phi(x)$ are then obtained in terms of the nature of the values of these derivates.

81. On Riemann-Stieltje's integral.

D. N. SEN, Patna.

It is well known that for Stieltje's integral the property

$$\int f d\phi + \int \phi df = f(b) \,.\, \phi(b) - f(a) \,.\, \phi(a)$$

holds good. Pollard remarked in Q.J.M., Vol. 49 that for the Modified Stieltje's Integral the property may or may not hold good. It is proved in this paper that it is true for the Modified Stieltje's Integral as well.

82. On certain functions which are self-reciprocal in the Hankel-transform.

S. C. DHAR, Nagpur.

A function $\phi(x)$ is said to be self-reciprocal in the Hankel transform, if

$$\phi(x) = \int_0^\infty \sqrt{xt}\, J_2(xt)\phi(t)\, dt,$$

where $v \geqslant -\frac{1}{2}$ and is called R_v. If however $v = \pm\frac{1}{2}$, then it reduces to the Fourier sine or cosine transform. The functions of the latter two classes are described as R_s and R_c respectively.

Hardy and Titchmarsh were the first to draw attention to such self-reciprocal functions and to obtain theorems relating to them. Afterwards many workers have written on the subject. In this paper some Whittaker and other functions which are self-reciprocal have been investigated.

83. On the sets of transformations which convert a simple continued fraction into a half-regular one.

A. A. KRISHNASWAMI AYYANGAR, Mysore.

We owe to Lagrange a regular method of converting the negative partial numerators of a Continued Fraction into positive ones. It is proposed to study here the converse transformations which convert a

Simple Continued Fraction into what Perron calls a Half-regular Continued Fraction.

This paper is a preliminary survey, which envisages completely these transformations and points out some of their properties. There are only eight such transformations which fall naturally into three groups: (C, C_1, C_2, C_3); (P); and (E_1, E_2, E_3), having respectively the property of *contracting, preserving* and *extending* the number of terms to which they are applied.

A detailed exposition of other properties and uses of these transformations will be given later on. For example, it will be shown that if C be excepted, the *contracting* and *preserving* sets have the faculty of making the residues numerically less than $(\sqrt{5}-1)/2$, while the *extending* set introduces residues numerically greater than $(\sqrt{5}-1)/2$. Tietze's 'raschesten Kettenbrüchen' follow in the wake of the former transformations and include a special variety which generally simulates the Simple Continued Fraction for quadratic irrationals.

84. The differentiation of multiple integrals.

C. Racine, Trichinopoly.

The object of this paper is to propose a formula for the differentiation of a multiple integral over p-dimensional varieties immersed in an n-space, when these varieties depend on one parameter. This formula is a little simpler than the one proposed by Prof. G. Giraud in 'Annales de L'Ecole Normale Supérieure', 1926, XLIII, pp. 6–25. Its demonstration is much shorter.

85. On a special net of Quadrics.

B. Ramamurti, Annamalainagar.

The special net of quadrics obtained by taking the polar quadrics of the points of a plane with respect to a cubic surface has been studied by Schur, Töplitz, Dixon and recently by W. L. Edge (*Proc. Edin. Math. Soc.* (1936) 185-209). It is well known that such a net arises also in the same manner from ∞^2 cubic surfaces whose sylvester pentahedra form a linear ∞^1 system circumscribed to a twisted cubic R^3. The pentahedra are self-conjugate with respect to the net of quadrics. Conversely, given a pencil of circumscribed pentahedra of R^3, there is a unique net of quadrics with respect to which they are self-conjugate. This point of view leads Edge to the generalization that there is a unique net of quadrics in $[n]$ with respect to which a pencil of $(n+2)$-hedra circumscribed to a rational norm curve are self-conjugate. The object of this paper is to furnish a simple proof of the above generalization by the method of binary apolarity, and study the special net in [3] by taking up the point of view of Edge and obtain the above results. It is further shown, by making use of a result of the author published in *Mathematische Annalen,* 1935 (582–586) that the ∞^2 cubic surfaces correspond in a one—one manner to the points of a rational normal surface V_2^8 in [9]. This determination of the exact structure enables us to explain the discrepancy between the values 18 of Töplitz and the value 14 of Edge, obtained for the degree of one of the two parameters in the equation of the ∞^2 cubic surfaces, and to point out that the really significant one is neither of the two, but the lowest value 4, which corresponds to the 'Minimal Abbildung of V_2^8'.

86. A new approach to the calculus.

John Maclean, Bombay.

Approach to the Calculus is usually cumbered by a premature explanation of fundamental ideas connected with limits. Confusion is later caused by the (essentially superfluous) use of differentials which appear to contradict the precision expressed in the theory of limits.

It is more natural (though probably paradoxical at first sight) to defer dealing with limits to as late a stage as possible. A full discussion of the Algebra of Increments gives the learner a chance to appreciate in an adequate degree the nature of functional variation, at the same time as he learns the essentials of the manipulative processes of the calculus. The transition from approximate equalities to the exact equations obtained from limits is then easily made, and the tremendous advantage of this is apparent.

This method has the great advantage of bringing out the intrinsic importance of a calculus of increments.

87. The arithmetic of Śrîdharâcârya.

A. N. Singh, Lucknow.

The present communication announces the discovery of a work called *Pâṭîgaṇita* by the famous Hindu mathematician Śrîdharâcârya who uptil now was believed to have flourished about the middle of the eighth century A.D. An abridgement of the above work, known as the *Triśatikâ*, is familiar to historians of mathematics. But the bigger work could not be found. An examination of the newly found work shows that Śrîdhara wrote before Brahmagupta (628 A.D.). Thus Śrîdhara must have lived in the sixth century and not in the eighth as has been believed uptil now.

The manuscript contains a commentary on the work, but the author of this commentary or the time of its composition cannot be determined with certainty as the manuscript is mutilated at the end. The importance of this discovery to historians of mathematics is great as a close study of the manuscript is expected to throw new light on many obscure problems relating to the history and development of mathematics in India.

88. On the distribution of Fisher's taxonomic coefficient.

P. C. Mahalanobis, R. C. Bose, *and* S. N. Roy, Calcutta.

In a paper published lately in the Annals of Eugenics (Vol. VII, Part II, September 1936, pp. 178–188) under the title 'The Use of Multiple Measurements in Taxonomic Problems' R. A. Fisher has obtained by the principle of maximization a certain expression based on sample readings, which he calls the taxonomic coefficient whose object is to test, on the hypothesis of a multivariate normal population, whether two samples can be reasonably supposed to have been drawn from two populations with the same means, it being known or assumed that the two populations have the same variances and co-variances. By certain general arguments and formal analogies with partial regression Fisher makes the distribution of this coefficient depend on his z-distribution, and then proceeds to numerical applications. The present paper makes use of hyperspace geometry and the rectangular co-ordinates developed earlier by the authors ('Normalization of Variates and the Use of Rectangular Co-ordinates in the Theory of Sampling Distributions' Sankhyā, Vol. 3, Part 1, 1937, pp. 1–40) to derive in full the sampling distribution of this coefficient. It is shown in conclusion that this is in entire agreement with the distribution supposed to be behind Fisher's numerical applications but not explicitly given in the Annals of Eugenics paper. The distribution of the coefficient, when the hypothesis tested is not true, is being worked out.

89. On the distribution of the means of a certain Bessel function distribution.

R. C. Bose, Calcutta.

S. Bose has made a critical study of the following Bessel function distribution :—

$$f(x)\,dx = Ce^{-\alpha x}\,x^{m/2}\,I_m\,(q\sqrt{x})\,dx,$$

where

$$C = (2/q)^m\,\alpha^{m+1}\,e^{-q^2/4\alpha}, \quad \text{and} \quad q \geqq 0,\, \alpha \geqq 0,\, m > -1.$$

This distribution first arose in a specialized form in connection with the researches of the present author on the exact distribution of the D^2-statistics. In the present paper the distribution of the mean, of a random sample of n, from this population is found. It comes out as

$$C'e^{-n\alpha\bar{x}}\,\bar{x}^{(mn+n-1)/2}\,I_{mn+n-1}\,(nq\sqrt{\bar{x}})\,d\bar{x},$$

where

$$C' = (2/nq)^{mn+n-1}\,(n\alpha)^{n(m+1)}\,e^{-nq^2/4\alpha}.$$

Hence the distribution of the mean is of the same type as the mother population. Since the type III distribution is a special case of the distribution investigated here, Irwin's distribution of the mean of a random sample of n from a type III population follows as a corollary.

90. On a new type of Bessel function distribution.

S. S. Bose, Calcutta.

The properties of the following Bessel function distribution :—

$$df(y) = \text{const. } y^{n/2} \,.\, e^{-\alpha y} \,.\, I_n(k\sqrt{y})\,dy$$

as a graduating frequency curve have been investigated. The moments of the equation have been calculated and its region in the β_1—β_2 plane indicated. Some well-known distributions have been deduced from it as special cases and finally, the actual method of fitting a curve has been illustrated as an example.

91. A geometrical note on the use of rectangular co-ordinates in the theory of sampling distributions connected with a multi-variate normal population.

S. N. Roy, Calcutta.

If in a space of any number of dimensions n, p vectors a_i are given ($i = 1, 2, \ldots . p$ and $p \leqslant n$) and if the scalar products of any two of them is a_{ij}($i = 1,\ 2, \ldots . p$; $j = 1,\ 2,\ \ldots . p$) *then it is easily seen that the* minor of a_{ij} in the determinant $| a_{ij} |$ is the scalar product in the space ($a_1, a_2, \ldots a_p$) of area formed by vectors ($a_1, a_2, \ldots a_{i-1}, a_{i+1}, \ldots a_p$) and area formed by vectors ($a_1, a_2, \ldots a_{j-1}, a_{j+1}, \ldots a_p$), and the minor of a_{ij} in $| a_{ij} |$ divided by determinant is equal to $\cos \theta_{ij} \mid q_i \cdot q_j$ where θ_{ij} = angle between the above hyperplanes and q_i and q_j are perpendiculars from the ends of a_i and a_j on ($a_1, a_2, \ldots a_{i-1}, a_{i+1}, \ldots a_p$) and ($a_1, a_2, \ldots a_{j-1}, a_{j+1}, \ldots a_p$). In a paper published in Sankhyā (Vol. 3, Part 1, 1937, pp. 1–40), under the title 'Normalization of Statistical Variates and the Use of Rectangular Co-ordinates in the Theory of Sampling Distributions', by P. C. Mahalanobis, R. C. Bose and S. N. Roy, while many results followed from the use of hyperspace geometry, several important derivations involved the processes of algebraic induction which were not fully carried through in that paper. The present note replaces the algebraic induction of that paper by pure hyperspace geometry and thereby (i) connects the matrix of rectangular co-ordinates $\| t_{ij} \|$ for the sample with the sample dispersion matrix $\| a_{ij} \|$, (ii) shows how the fundamental quadric (9.9, p. 16 of the Sankhyā paper) is reduced to the sum of squares by the transformation (11.6, p. 20), and (iii) derives t_{ij}'s in terms of l_{ij}'s (11.6, p. 20) giving incidentally a very simple geometrical interpretation of the coefficients of l_{ij}'s when t_{ij}'s are expressed in terms of l_{ij}'s, and also of other algebraic expressions occurring in that paper.

92. The median versus the mean or any other statistic in tests of significance.

S. R. Savur, Poona.

It is shown in this paper that a general test of significance, that is a test of significance which is applicable to all cases irrespective of the frequency distributions, is better than a special significance test, that is a test which is accurate only for a particular frequency distribution or distributions. Of all the general tests that can be visualized at present the म test is the simplest. It is also simpler than the existing special tests. Hence the suggestion is made that the म test may be used more and more widely in place of the existing tests.

93. The performance test.

S. R. Savur, Poona.

The principle of the performance test is quite general. In this paper some of the applications of the test are given.

94. On Fisher's combinatorial methods giving moments and cumulants of the distributions of *k*-statistics.

P. V. Sukhatme, Cawnpore.

The origin of Fisher's combinatorial method of evaluating any single term in a cumulant of the distribution of *k*-statistics is discussed. It is shown that his method is a natural combination of the algebraic processes into a single operation. A parallel combinatorial method of evaluating the coefficient of the moment term in the moment of the distribution of powers and products of any *k*'s is also given.

95. The Ogive.

N. Sundara Rama Sastry, Madras.

From the properties of the Ogive curve of any frequency distribution of ' Pearson's types ' with high contact at both ends, an empirical formula is derived to give the equation of the curve. From this equation, the methods of obtaining the mode, median and quartils are described.

96. On the distribution of χ^2 in samples of the Poisson series.

P. V. Sukhatme, Cawnpore.

Experimental evidence regarding the lower limit of the parameter at or above which the χ^2 for samples of the Poisson series follows the ordinary Pearsonian χ^2 distribution is obtained. It is found that when the parameter has a value larger than one and the sample size is not too small, the theoretical distribution of χ^2 is sufficiently closely realized for all practical purposes. It is also found that the approximation improves as the sample size increases. It is, however, emphasized that the approximation is theoretically independent of the sample size, the presence of the feature being due to the limited number of different values which the χ^2 assumes when the sample values are all integers and the size and the parameter are small.

97. On Fisher and Behrens' test of significance for the difference in means of two normal samples.

P. V. SUKHATME, Cawnpore.

The method of tabulating the 5 per cent. values of Fisher and Behrens' d' test of significance for the difference in means of two normal samples is discussed and in particular the 5 per cent. values of the quantity d' for equal values of n_1 and n_2 are tabulated. It is found that although for $n_1 = n_2 = 1$ the d' 5 per cent. value is larger when the variances of the sample means are equal than when they are unequal, this is not true when $n_1 = n_2 = 5$ or larger. Bartlett's expectation based on his distribution of d' for small odd values of n_1 and n_2 is thus shown to be falsified.

The test is also compared with Smith's approximation and student's t-test in common use.

A table is provided giving values of the ordinates of student's t-curve for the sequence 10, 12, 15, 20, 30, 60 . . . ∞ and the nine values less than 10.

98 Remark on a conjecture of Sylvester.

S. CHOWLA, Lahore.

It is proved that Sylvester's conjecture that

$$\frac{3}{\pi^2}x^2 < \sum_{1}^{x} \phi(n) < \frac{3}{\pi^2}(x+1)^2$$

where $\phi(n)$ is Euler's totient function, and x is a positive integer, is false for infinitely many positive integers x.

SECTION OF CHEMISTRY

President :—S. S. BHATNAGAR, O.B.E., D.SC., F.INST.P., F.N.I.

Inorganic Chemistry

1. An improved method of hydrogen estimation in gas analysis.

H. N. BANERJEA, Bombay.

The difficulties in correctly estimating hydrogen in the presence of hydrocarbon gases by the fractional combustion method in the Lunge Orsat gas analysis apparatus have been overcome.

Amongst the various substances examined for the purpose, dinitrosoresorcinol gave satisfactory results. Of palladium, platinum and nickel catalysts with dinitrosoresorcinol, nickel catalyst supported on Kieselguhr was found to meet the requirements.

The method of preparing the catalyst is given and the experimental details of carrying out the determination reported.

2. Sulphur iodide.

M. R. ASWATHNARAYANA RAO, Bangalore.

The existence of sulphur iodide has been a matter of controversy. Experimental evidence presented in this paper tends to show that sulphur iodide, though highly unstable, can exist for a time in carbon tetrachloride solutions. A dilute solution of sulphur chloride in carbon tetrachloride, when treated with dry potassium iodide at 0°C., gives a yellow solution of sulphur iodide, which, on keeping, decomposes to produce iodine and free sulphur. The iodine liberated is a qantitative measure of sulphur chloride present and iodometric titration can be employed to estimate accurately the sulphur chloride. The absorption spectra of the yellow solution have been studied and support the view that sulphur iodide has been formed by the above reaction. An increase of temperature hastens the decomposition of the iodide.

3. Constitution of iodic acid.

M. R. NAYAR, L. N. SRIVASTAVA, *and* A. B. SEN, Lucknow.

Iodic acid in aqueous solution has been shown to be polymerised, the polymerisation depending upon the concentration (Proc. Ind. Sci. Cong., 1937). In order to find out at what concentration a change in constitution, if any, takes place a number of physical properties were studied and their graphs compared. The following mixture law equation was employed :

$$P_{\text{soln}} = (1-x)P_{\text{solvent}}\ (x)P_{\text{solute}}.$$

where P denotes the physical property like density, viscosity, surface tension, parachor, refractive index, etc. and (x) and $(1-x)$ the mol fractions of the solute and solvent, respectively. P_{solute} is plotted against concentration. There is a remarkable similarity in the behaviour of various graphs, all showing definite breaks in the curves at two points corresponding to concentrations 0·1N and 0·04N.

When the degree of dissociation is determined by the conductivity method $(\alpha = \Lambda_v/\Lambda_\infty)$ and plotted against log concn. a straight line graph is obtained with horizontal steps at 0·08N and 0·045N in very good agreement with the other graphs.

The dissociation curves were obtained for two temperatures 30° and 40°. While the degree of dissociation of the acid at 30° is 91% for 0·01N and 38% for 1·0N, the values at 40° for the same solutions are 92% and 37%, that is 1% higher for the dilute solution and 1% lower for the concentrated solution.

These observations are in conformity with the explanation offered previously, viz. the equilibrium:

$$\begin{tikzcd}[column sep=small] 1/3(HIO_3)_3 \arrow[r, shift left] & 1/2(HIO_3)_2 \arrow[l, shift left] \arrow[r, shift left] & HIO_3 \arrow[l, shift left] \arrow[d, shift right] \\ & & H+IO_3. \arrow[u, shift right] \end{tikzcd}$$

4. Decomposition of chromates at high temperatures, Part I. The decomposition of calcium chromate.

V. T. Athavale *and* S. K. K. Jatkar, Bangalore.

The dissociation pressure curve of calcium chromate was studied and shows three stepouts in the curve at 800°, 850° and 920° corresponding with 50, 66·6 and 75 per cent. decomposition. The products corresponding to these stages and which resisted further decomposition at the temperatures of the experiments had the following compositions, viz. $8CaO.4CrO_3.2Cr_2O_3$; $3CaO.CrO_3.Cr_2O_3$; $8CaO.2CrO_3.3Cr_2O_3$. All these dissolve partly in acids leaving an insoluble residue which was identified as calcium chromate. The composition of the acid soluble portions was $8CaO.4CrO_3.Cr_2O_3$; $9CaO.4CrO_3.Cr_2O_3$ and $17CaO.6CrO_3.2Cr_2O_3$ respectively. The heats of decomposition of calcium chromate and the various intermediate compounds were calculated by the Nernst equation and were 54·3, 56·3, 63·0 and 74·0 calories for 50, 66·3, 75 and 100% decomposition respectively.

5. Decomposition of chromates at high temperatures, Part II. The decomposition of mixtures of calcium chromate with calcium carbonate.

V. T. Athavale *and* S. K. K. Jatkar, Bangalore.

The decomposition was studied by mixing the chromate and carbonate in the required proportion. It was noticed that so far as the equilibrium between CrO_3 and Cr_2O_3 is concerned there are only two stages in the decomposition corresponding to 33·3 and 40 per cent. decomposition. It was found that at any particular temperature the amount of the acid insoluble portion, i.e. calcium chromite from the decomposed product decreases linearly with an increase in the amount of lime added while the amount of the acid soluble portion without any change in its composition correspondingly increases. When the amount of CaO added is sufficient to convert all the Cr into the intermediate compound no acid insoluble residue is left. A supplementary fact is that if, instead of the addition of CaO, chromic oxide is added to the chromate in quantities sufficient to form the chromite, no acid soluble portion but only the insoluble chromite is obtained.

The study therefore reveals that the three intermediate compounds formed in the decomposition are (1) $8CaO.4CrO_3.Cr_2O_3$, (2) $9CaO.4CrO_3.Cr_2O_3$ which correspond to 33·3 per cent. decomposition and $17CaO.6CrO_3.2Cr_2O_3$ corresponding to 40 per cent. decomposition, the

50, 66·6 and 75 per cent. products for plain chromate being shown to be mixtures of these compounds in order and calcium chromite.

6. Decomposition of chromates at high temperatures, Part III. The decomposition of strontium chromate.

V. T. ATHAVALE *and* S. K. K. JATKAR, Bangalore.

The vapour pressure curve of strontium chromate (m.p. with decomposition 1160°) up to 1400° was studied. Strontium chromate like calcium chromate shows three breaks in the curve at 945°, 1125° and 1255° which correspond to 50, 66·6 and 75 per cent. decomposition respectively.

The products of decomposition dissolve partly in acetic acid, the part insoluble in acid being chromic oxide for the 50 per cent. product and strontium chromite for the two other stages. The acid soluble portion had the same composition as in the case of calcium chromates, viz. $8SrO.4CrO_3.Cr_2O_3$; $9SrO.4CrO_3.Cr_2O_3$ and $17SrO.6CrO_3.2Cr_2O_3$ respectively.

The corresponding heats of decomposition were 64·0, 78·0 and 88·2 calories for the 50, 66·6 and 75 per cent. decomposition respectively.

7. Decomposition of chromates at high temperatures, Part IV. The decomposition of mixtures of strontium chromate and strontium carbonate.

V. T. ATHAVALE *and* S. K. K. JATKAR, Bangalore.

A study of the decomposition of these mixtures supported the results obtained with calcium salts. The 50% decomposition product for plain strontium chromate is shown to be a mixture $8SrO.4CrO_3.Cr_2O_3$ and Cr_2O_3, while the 66·6 and 75% decomposition products are shown to be mixtures of the strontium chromite and $9SrO.4CrO_3.Cr_2O_3$ and $17SrO.6CrO_3.Cr_2O_3$, respectively.

A curious fact about the decomposition of these mixtures is that while pure strontium chromate begins to dissociate at 925° and pure strontium carbonate at 775° a mixture of the two begins to dissociate at 600° only. All the mixtures have got definite decomposition pressures at a particular temperature. Analysis of the gas phase shows that oxygen and carbon dioxide are in such proportions that only as much strontium carbonate is decomposed as is necessary for the formation of the intermediate compound.

8. Decomposition of chromates at high temperatures, Part V. The decomposition of barium chromate.

V. T. ATHAVALE *and* S. K. K. JATKAR, Bangalore.

The dissociation pressure of barium chromate has been measured. The decomposition of chromate in vacuo at 1265° showed 50 per cent. decomposition. The 50 per cent. stage had practically no vapour pressure even up to 1420°. The behaviour of the 50 per cent. stage towards acid was exactly the same as for strontium chromate. The heat of decomposition of barium chromate into the compound corresponding to the first stage was 76·0 calories.

9. Decomposition of chromates at high temperatures, Part VI. The decomposition of mixtures of barium chromate with barium carbonate.

V. T. ATHAVALE *and* S. K. K. JATKAR, Bangalore.

A study of the decomposition of these mixtures gave the same results as in the case of calcium and strontium salts.

The reaction between the chromate and carbonate is found to be more easy than in the case of strontium. The mixtures begin to dissociate at 740° while the dissociation temperatures for pure chromate and carbonate are 1200° and 1000° respectively. All mixtures have got definite vapour pressure at a particular temperature while the analysis of the gas phase confirmed the results given in Part IV. The intensity of the reaction between the chromate and carbonate increases in the order: calcium, strontium and barium.

10. New compounds of gallium, Part III.

P. Neogi *and* S. K. Nandi, Calcutta.

Gallium chlorate, bromate, iodate, basic iodate, phosphate, propionate, butyrate, maleate. fumarate, citraconate, mesaconate, silicate, molybdate and tungstate have been prepared.

11. New compounds of gallium, Part IV.

P. Neogi *and* N. K. Dutt, Calcutta.

Double oxalates of gallium with sodium, potassium and ammonium have been prepared. Attempts are being made to resolve them into optical isomers.

12. Experiments to resolve co-ordinated inorganic compounds into optical isomers, Part III. Co-ordinated compounds of zinc with active and racemic propylenediamine.

P. Neogi *and* K. L. Mandal, Calcutta.

Fifteen new compounds of tri-propylenediamine (*r*-, *d*- and *l*-) with zinc salts have been obtained and the rotations of the active varieties have been measured.

13. Experiments to resolve co-ordinated inorganic compounds into optical isomers, Part IV. Co-ordinated aluminium compounds.

P. Neogi *and* N. K. Dutt, Calcutta.

Wohl has succeeded in resolving the ammonium aluminium oxalate but obtained the *d*- variety only. We have, however, been able to obtain the *l*- variety also in solution. The potassium compound has also been resolved, the *d*- compound being obtained in the solid condition and the *l*- variety in solution.

14. Fluoberyllates and their analogy with sulphates—fluoberyllates of metal-ammine complexes.

N. N. Ray, Rajshahi.

In previous communications (*Z. anorg. u. allg. Chem.*, *201*, 289, 1931; *205*, 257, 1932; *206*, 209, 1932; *227*, 32, 103, 1936), it has been shown that the fluoberyllate ion is analogous to the sulphate ion. Several simple and double fluoberyllates, isomorphous with the corresponding simple and double sulphates, have already been studied. In the present communication complex compounds containing the fluoberyllate ion are described. The following metalammine complexes have been prepared:—

Tetrammino silver fluoberyllate (anhydrous), tetrammino silver fluoberyllate dihydrate, tetrammino cupric fluoberyllate monohydrate, diammino cupric fluoberyllate, tetrammino zinc fluoberyllate, tetrammino cadmium fluoberyllate, hexammino nickel fluoberyllate, diammino nickel fluoberyllate, hexammino cobaltic fluoberyllate trihydrate, hexammino cobaltic chlorofluoberyllate and hexammino nickel fluoberyllate potassium iodide.

These are analogous to the corresponding metal ammine sulphates.

15. Complex compounds of biguanid with tervalent metals. Chromium-biguanid bases and their salts, Part II.

P. R. RAY *and* H. B. SAHA, Calcutta.

In continuation of our previous work (Part I, communicated to the *Journal of the Indian Chemical Society*) on chromium tribiguanid bases and its salts, we have now found that the latter undergo gradual hydrolysis giving rise to a new series of complex compounds with elimination of one molecule of biguanid. The base and a number of salts of this series have been prepared and their properties studied. The constitution of the complex, forming this new series, is represented by a bivalent hydroxo-aquo-chromium-dibiguanid ion, the hydroxo- and the aquo-group occupying cis-positions in the complex. Incidentally, a strange property of the aged solutions of chloride and bromide of this series in holding the silver halides in colloidal solution has been noticed.

16. Complex compounds of biguanid with tervalent metals. Chromium-biguanid bases and their salts, Part III.

P. R. RAY *and* N. N. GHOSH, Calcutta.

It has been shown in Part I of this series (communicated to the *Journal of the Indian Chemical Society*) that biguanid combines with chromium salts to form complexes of hexammine type—chromium tribiguanid base and its salts. A similar series of compounds has now been obtained with a substituted biguanid like phenylbiguanid. The preparation and properties of this chromium tri-phenylbiguanid base and salts form the subject matter of the present paper.

Physical Chemistry

17. Resonance and molecular structure. (A discourse.)

J. E. LENARD JONES, Cambridge.

18. Photosynthesis of carbohydrates in vitro. (A discourse.)

E. C. C. BALY, Liverpool.

19. A proposed general theory for the molecular structure of the polyhalides of the alkali metals, hydrogen and ammonia from the standpoint of the electronic configuration.

R. R. GOREY, Benares.

The formulæ suggested by Sidgwick and others for the structure of polyhalides postulate, in the main, a central halogen atom with 10 or 12 electrons functioning covalently. It has been shown that this assumption leads to certain deductions not warranted by facts. The covalent structure for the interhalogen compounds and the similarity in the structures of the interhalogen compounds and the polyhalides as assumed by previous workers has been shown to be inadmissible.

Definite evidence has been given from which the existence of a sextet in a halogen molecule like I_2 and Br_2 can be reasonably assumed. The possible consequences of a nuclear sextet in the interhalogen compounds and the completion of the sextet to a more stable octet, by means of co-ordinate linkages, in the molecule of a polyhalide have been worked out.

This has been found to be in fuller agreement with the chemical and physical behaviour of the interhalogen compounds as well as the polyhalides. Further, on these assumptions the postulation of the inertness of a pair of electrons as proposed by Sidgwick becomes unnecessary.

20. The specific resistance of metals subjected to tension and torsion.

G. Ramarao, Bangalore.

An attempt is made to study the influence of tensile and torsional forces on the specific resistance of metals. This paper deals with the effect of these forces on the specific resistance of mild steel. The tensile force is applied to a standard test piece on a Buckton testing machine. It was found that the specific resistance decreased. Torsional forces were found to have no effect on the specific resistance. The micro structure of the test piece before and after tension revealed certain interesting features.

21. An X-ray investigation of the crystals of *o*- and *p*-benzotoludides.

Mata Prasad *and* A. B. Khan, Bombay.

(1) The crystals of *o*-benzotoludide belong to the rhombic bipyramidal class and crystallographic measurements give the axial ratio, $a : b : c = 2{\cdot}8607 : 1 : 1{\cdot}0815$ (cf. Groth V, p. 166).

The crystals were studied by the rotation methods and the following values were found for the lengths of the axes.

$$a = 26{\cdot}116\ \text{Å}, \quad b = 9{\cdot}117\ \text{Å}, \quad c = 9{\cdot}870\ \text{Å}$$

which give $a : b : c = 2{\cdot}8645 : 1 : 1{\cdot}0825$. The planes (okl), (hko) and (hol) are halved when k, h and l, respectively are odd. The crystals belong to the space group Q_h^{15} and the unit cell contains 8 molecules which are asymmetric.

(2) The crystals of *p*-benzotoludide belong to the rhombic class and the axial ratio, $a : b : c = 1{\cdot}8469 : 1 : 0{\cdot}2810$ (cf. Groth V, p. 165).

The X-ray photographs give $a = 30{\cdot}54$ Å; $b = 8{\cdot}24$ Å; $c = 9{\cdot}246$ Å and $a : b : c = 3{\cdot}707 : 1 : 1{\cdot}122$.

This shows that the a-axis is doubled and the c-axis is quadrupled. The planes (hol) are halved when l is odd and (hko) halved when h is odd. The crystals belong to the space group Q_h^{11} and the unit cell contains 8 asymmetric molecules.

22. An X-ray investigation of the crystals of *p*-nitraniline, *p*-nitrotoluene and 1 : 8-dinitro naphthalene.

Mata Prasad *and* R. N. Merchant, Bombay.

The crystals of *p*-nitraniline belong to the monoclinic prismatic class and the axial ratio is

$$a : b : c = 2{\cdot}5198 : 1 : 1{\cdot}4215$$

(cf. Groth IV, p. 181).

The X-ray photographs give

$a = 15{\cdot}31$ Å; $b = 6{\cdot}085$ Å; $c = 8{\cdot}633$ Å

and $a : b : c = 2{\cdot}516 : 1 : 1{\cdot}419$.

The crystals of *p*-nitrotoluene belong to the rhombic bipyramidal class and the axial ratio is

$a : b : c = 0{\cdot}9111 : 1 : 1{\cdot}1097$ (cf. Groth).

The X-ray photographs give

$a = 6{\cdot}409$ Å; $b = 15{\cdot}40$ Å; $c = 14{\cdot}096$ Å

and $a : b : c = \frac{1}{2}(0{\cdot}9094) : 1 : 1{\cdot}105$.

The unit cell contains 8 molecules.

The crystals of 1 : 8 dinitro naphthalene belong to the rhombic bipyramidal class. The axial ratio is

$a : b : c = 0{\cdot}3599 : 1 : 0{\cdot}7527$ (cf. Groth V, p. 372).

The X-ray photographs give

$a = 5{\cdot}390$ Å; $b = 14{\cdot}99$ Å; $c = 11{\cdot}35$ Å

and $a : b : c = 0{\cdot}3595 : 1 : 0{\cdot}7571$.

The until cell contains 4 molecules.

23. Absorption spectra and magneto-optical rotation of liquid mixtures.

P. L. Kapur *and* M. R. Verma, Lahore.

Absorption spectra and the magneto-optical rotation of binary liquid mixtures comprising both polar and non-polar constituents have been measured. The results are discussed from the point of view of dipole association and molecular compound formation.

24. Magnetic susceptibility and particle size.

S. S. Bhatnagar, M. R. Verma, *and* P. N. Dhir, Lahore.

The magnetic susceptibility of various grades of chemically pure powders of white tin down to about 0·5 has been measured and found to be constant. These results are in line with the previous observations reported from this laboratory for Bi, Sb, Pb, Cu, S and Te.

25. Diamagnetic susceptibilities of mercury in various states of combination.

S. S. Bhatnagar, M. B. Nevgi, *and* G. L. Ohri, Lahore.

In this communication the diamagnetic susceptibility constants of mercury in different states of linkage have been critically examined. Data for inorganic, organic and semi-organic mercuric compounds, mercurous inorganic compounds, double salts of mercury and mercury salts in the dissolved state have been given. The specific and atomic susceptibilities of mercury are almost the same as obtained by Vogt, Bates and Tai. The susceptibility constants for mercury in the divalent state from inorganic compounds lie between $-46{\cdot}0 \times 10^{-6}$ and $-48{\cdot}0 \times 10^{-6}$ while those from the true organic compounds come out to be $-35{\cdot}0 \times 10^{-6}$ to $-37{\cdot}0 \times 10^{-6}$. The susceptibility constants from semi-organic compounds lie in between the two values mentioned above. The difference has been explained on the assumption of the difference in the degree of dissociation causing the deformation in the ions to a different extent. The mercurous compounds are all diamagnetic. The constants for mercurous mercury are $-(51{\cdot}6)_2 \times 10^{-6}$ and $-(53{\cdot}6)_2 \times 10^{-6}$. The molecular diamagnetic susceptibilities of mercury double salts are slightly higher than the sum of the constitutive simple salts. This increment has been explained on the co-ordinate linkage. The specific susceptibilities of mercury salts in pyridine are rather low when compared with those in the solid state. This abnormal behaviour has been explained on the complex formation in organic solvents such as pyridine.

26. Diamagnetism of colloidal electrolytes.

M. B. Nevgi, Lahore.

The object of the present investigation is to study the constitution of the colloidal electrolytes by investigating the diamagnetic susceptibilities of some potassium and sodium salts of the fatty acids in the solid state. From the results obtained it appears that there is a substantial agreement between the theoretical and experimental diamagnetic molecular susceptibilities of sodium and potassium salts of the lower fatty acids as the general expression :

$$\chi_M = \chi_{\text{ion}}^{+} + \chi_{\text{ion}}^{-}$$

holds good, these compounds being strong electrolytes. However, no such agreement is seen in the case of the salts of the higher fatty acids. The experimental diamagnetic susceptibilities of these salts are decidedly lower than the theoretical values. This anomalous behaviour has been attributed to the micelle formation, low electrical conductivity and degree of dissociation which may be deforming the ionic radii owing to the limitation of the effective spread of the electron density distribution on which diamagnetism mainly depends.

27. Diamagnetic susceptibilities of some inorganic liquid compounds.

M. B. Nevgi, Lahore.

The specific and molecular susceptibilities of some inorganic liquid compounds such as SCl_2, S_2Cl_2, $SOCl_2$, SO_2Cl_2, SO_3HCl, $SiCl_4$, $SiBr_4$, ICl and $POCl_3$ have been determined during this investigation. While finding out the diamagnetic susceptibility constants from them only Pascal's atomic diamagnetic values have been used as the compounds exist mostly in the covalent state. The various susceptibility constants are as follows :—

Sulphur in the divalent state	$-9{\cdot}0 \times 10^{-6}$
Sulphur in the tetravalent state	$-6{\cdot}8 \times 10^{-6}$
	$-5{\cdot}5 \times 10^{-6}$
Silicon in the tetravalent state	$-4{\cdot}2 \times 10^{-6}$
	$-3{\cdot}6 \times 10^{-6}$
Iodine in the positive monovalent state	$-3{\cdot}7 \times 10^{-6}$
Phosphorus in the pentavalent state	$-3{\cdot}3 \times 10^{-6}$

There is a substantial agreement between the theoretical and experimental diamagnetic susceptibility constants of the above elements in various states.

28. Diamagnetic susceptibilities of formic and acetic acid solutions.

V. NEHRA *and* M. QURESHI, Hyderabad (Deccan).

The diamagnetic susceptibilities of solutions of formic and acetic acid over a wide range of concentrations between 0% and 100% have been determined by Gouy's method. The accuracy of the measurements is about 0·5%. The results indicate definite departures from a linear change of susceptibility with concentration. The formic acid curve shows a minimum at about 77% and a maximum at about 30%. The former has been attributed to the existence of a complex formed by the close association of highly polar molecules of formic acid and water. The latter cannot be attributed solely to the depolymerisation of water molecules. The cause of it must be looked for in some kind of change taking place in the structure of the formate ion.

The acetic acid curve follows a linear course except for a single minimum at 77%, corresponding to the composition, CH_3COOH, H_2O. The existence of a monohydrate of acetic acid is also indicated by other physico-chemical data, such as those of viscosity, density and Raman effect.

29. The *p*H of aqueous solutions containing boric acid and hydroxylic substances.

S. M. MEHTA *and* (MISS) K. V. KANTAK, Bombay.

The hydrogen ion concentration of aqueous solutions containing boric acid and a hydroxylic substance such as mannitol, erythritol, glucose, galactose, maltose, mannose, tartaric acid, citric acid and others was measured at 30°C. using the quinhydrone method in conjunction with the electrometer triode circuit described by Mehta (*J. Univ. Bom.*, 1936, 5(2), 77). The concentrations varied between 0·2M and 0·005M while the ratio boric acid : hydroxylic substance was between 3 : 1 and 1 : 3. The *p*H has been plotted against concentration and against the ratio boric acid : hydroxylic substance. The results show that the *p*H-ratio curves are straight lines in the case of lævulose, galactose, malic acid, tartaric acid and oxalic acid while in the case of erythritol, glucose, mannose, mannitol and *p*-hydroxybenzoic acid maxima are obtained in the curves which indicate the possibility of complex formation.

30. Aqueous solutions of sodium aluminates.

(MISS) O. JOSEPH *and* MATA PRASAD, Bombay.

Solutions of aluminium hydroxide in sodium hydroxide containing different ratios of $Na_2O : Al_2O_3$ have been prepared by different methods and their electrical conductivities and hydrogen ion concentrations have been measured. The glass electrode has been employed for the measurement of the H-ion concentration. The results show a discontinuous variation in both the equivalent conductivity and H-ion concentration values with the change in the $Na_2O : Al_2O_3$ ratio.

On keeping solutions of aluminium hydroxide in solution of sodium hydroxide of various concentrations in vacuum, crystals have been observed to separate out. These have been analysed and formulæ have been assigned to them.

31. On an equation for the viscosity of binary systems.

P. B. GANGULY *and* S. K. CHAKRABERTTY, Patna.

In a previous paper (*Zeit. anorg. Chem.*, *231*, 304, 1937) the viscosity of ideal binary systems has been sought to be expressed by the formula

$\log \eta/\eta_1 = Ax_2 + C$, where x_2 represents the molar fraction of one of the components. This equation has been further examined for twelve more systems and has been found to be applicable. It has been found that the above expression can be deduced from Andrade's equation

$$\eta v^{\frac{1}{3}} = Ae^{\frac{cv}{T}}$$

on the basis of certain assumptions. The assumptions have been discussed and an attempt has been made to apply the above equation to the case of non-ideal systems.

32. Vapour phase esterification equilibria.

T. SUBRAMANYA *and* S. K. K. JATKAR, Bangalore.

We have studied the equilibria in the catalytic esterification of acetic acid by isoamyl alcohol. A limit is reached at about 50 per cent. conversion of equimolecular mixture although the actual limit is considerably higher, owing apparently to the simultaneous establishment of other equilibria as in the case of ethyl alcohol and acetic acid.

33. Primary and secondary dissociation constants of cis- and trans-norpinic, pinic, and trans-caronic acids.

C. T. ABICHANDANI *and* S. K. K. JATKAR, Bangalore.

Electrometric titration of cis- and trans-norpinic acids, pinic acid, and trans-caronic acid has been carried out for the determination of the titration curve and calculation of the first and second dissociation constants with a view to throw light on the configuration of the acids. A study of the comparison of the first and second dissociation constants of the homologous straight chain dicarboxylic acids with the corresponding cyclobutane dicarboxylic acids has been made which enables the decision in regard to the cis-trans configuration of the pinic and norpinic acids. Thus the trans structure of pinic acid has been confirmed. The following are the values of dissociation constants K_1 and K_2 respectively :—

(1) Cis-norpinic acid, $K_1 = 1{\cdot}34 \times 10^{-4}$, $K_2 = 3{\cdot}75 \times 10^{-6}$,
(2) Trans-norpinic acid, $K_1 = 3{\cdot}8 \times 10^{-4}$, $K_2 = 6{\cdot}7 \times 10^{-6}$,
(3) Pinic acid, $K_1 = 1{\cdot}37 \times 10^{-4}$, $K_2 = 6{\cdot}05 \times 10^{-6}$,
and (4) Trans-caronic acid, $K_1 = 2{\cdot}48 \times 10^{-4}$, $K_2 = 7{\cdot}9 \times 10^{-6}$.

34. The kinetics of the heterogeneous reaction between chromic sulphate and manganese dioxide.

MATA PRASAD *and* M. A. NAQVI, Bombay.

Manganese dioxide has been prepared by various methods and its rate of reaction with chromic sulphate solutions studied at different temperatures using (1) particles of different size, (2) different amounts of manganese dioxide, and (3) different concentrations of chromium sulphate solution. It has been observed that the reaction commences as soon as chromic sulphate solution is added to manganese dioxide and is very rapid in the beginning but slows down considerably after some time.

35. The hydrolysis of sulphur chloride at the interface between carbon tetrachloride and aqueous sodium hydroxide.

B. S. RAO, Bangalore.

Further work on hydrolysis of sulphur chloride is reported (cf. B. S. Rao, *Proc. Ind. Sci. Congress*, 1931). The hydrolysis of sulphur chloride at the interface between carbon tetrachloride and aqueous sodium hydroxide yields free sulphur in the carbon tetrachloride solution and sulphide, sulphite, and thiosulphate in the aqueous phase. Disulphur oxide (S_2O) seems to be the primary product of the reaction. This rapidly decomposes at the interface giving sulphur in the carbon tetrachloride solution and sulphur monoxide in the aqueous phase. The sulphur monoxide readily forms thiosulphate with the alkali. Part of the disulphur oxide reacts with alkali to give the sulphide and the sulphite of sodium. It is shown that the sulphur in the carbon tetrachloride solution and the thiosulphate in the aqueous solution are not produced by any secondary reaction between sulphide and sulphite.

36. A possible suppression of hydrolysis of mercuric chloride in aqueous solution by benzoic acid.

D. N. SOLANKI, Benares.

The results for the specific conductivity of benzoic acid at N/100, N/150 and N/200 in the presence of $HgCl_2$ in the range 0·25N to 0·01878N at 25°C. show that the above quantity is diminished in the presence of the latter. This diminution at a given concentration of benzoic acid is sensible only at larger dilutions of $HgCl_2$.

The comparison of the reduced (i.e., corrected for the hydrolysis of $HgCl_2$, the degree of hydrolysis for the dilutions used being extrapolated from Ley's data (*Z. physikal. Chem.*, *30*, 249, 1899), specific conductivity of benzoic acid with the actual value in the mixture obtained by difference shows that the common ion effect, arising out of the hydrolysis of $HgCl_2$ is one factor leading to a diminution in specific conductivity of benzoic acid.

Results for the specific conductivity, corrected for hydrolysis, depart from those obtained by difference or by the additive law, in the case of strong solutions of $HgCl_2$. This discrepancy might arise possibly from the fact that extrapolation made on the assumption, viz., negligibility of hydrolysis at very high concentration, is not rigorously accurate, i.e. it indicates more hydrolysis than what obtains under the conditions. The assumption that a weak acid like benzoic acid would not affect the conductivity due to a strong electrolyte like NaCl, KCl, etc., however, does not seem to be strictly true in the case of $HgCl_2$, which agrees with the fact that $HgCl_2$ stands apart from the strong electrolytes in having some of the properties of a weak electrolyte. It is likely that this hydrolysis is sensibly suppressed by the presence of benzoic acid. Simms (*J. Phys. Chem.*, *33*, 745–754, 1929) has shown some evidence for the possible inactivation of a weak electrolyte in the presence of another. The divergence from the specific conductivity of benzoic acid deduced from the additive law, of its conductivity, when corrected for hydrolysis of $HgCl_2$ is greater the greater the concentration of benzoic acid, which suggests that since the extrapolation is a common factor, the above hydrolysis is affected (suppressed) by benzoic acid.

37. Circular dichroism observed in sols of tungstic acid, vanadic acid and chromic tungstate.

J. C. GHOSH, T. BANERJEE, *and* S. K. MUKHERJEE, Dacca.

Weigert discovered the important fact that light might act as an orienting force upon colloidal systems in the solid gel form. A photochloride exposed to strong plane polarised light shows photodichroism. Zocher has shown that similar experiments with circularly polarised light on a thin layer of photochloride produced circularly dichroic spots. We have prepared sols of tungstic acid, molybdic acid, vanadic acid, uranic acid, chromic hydroxide and chromic tungstate. The sols have been matured by exposure to *d*- or *l*-circularly polarised light for 8 to 12 hours. No circular dichroism could be found except in the case of tungstic acid, chromic tungstate and vanadic acid sols. In the case of these sols, however, measurement of the extinction coefficient of *d*- and *l*-circularly polarised light at wavelength 366$\mu\mu$, gave values of anisotropy factor which are much greater than the limits of experimental error.

The results are given in Table I. It will be seen that the values of anisotropy factor are of the order of 0·028, which are comparable with the values obtained by Kuhn for solutions of optically active substances. The results clearly indicate that in these cases, during the process of the formation of the particles of the sol, circularly polarised light exercises an orienting effect resulting in the formation of an aggregate which exhibits optical anisotropy.

TABLE I.

Sol used with concentration (C).	Nature of light in which the sol was matured for H hrs. immediately after mixing the reagents or dialysis.	Absorption coefficient in *l*-circularly polarised light. (A_l)	Absorption coefficient in *d*-circularly polarised light. (A_d)	Anisotropy factor. $g = \dfrac{A_l - A_d}{\frac{1}{2}(A_l + A_d)}$
Tungstic acid .. C = 0·0125M .. H = 6 hrs.	*l*-circularly polarised	5·23	5·09	+0·0271
	d-circularly polarised.	4·91	5·02	−0·0221
	Plane polarised ..	4·83	4·87	−0·0082
	Unpolarised ..	5·32	5·29	+0·0056
	Kept in the dark ..	5·01	5·001	+0·0001
Vanadic acid .. C = 0·0025M H = 10 hrs.	*l*-circularly polarised.	5·62	5·46	+0·0289
	d-circularly polarised.	5·53	5·56	−0·0054
	Plane polarised ..	5·54	5·52	+0·0036
	Unpolarised ..	5·70	5·67	+0·0053
	Kept in the dark ..	5·76	5·71	+0·0087
Chromic Tungstate. C = 0·02M H = 10 hrs.	*d*-circularly polarised.	6·24	6·42	−0·0284
	Plane polarised ..	6·45	6·40	+0·0077
	Unpolarised ..	5·97	5·96	+0·0017
	Kept in the dark ..	5·97	6·01	−0·0067

38. Photo-reduction of aqueous solution of ferric chloride in the presence of aldehydes.

MATA PRASAD *and* C. R. TALPADE, Bombay.

The reduction of ferric chloride in the presence of formaldehyde and acetaldehyde has been studied in visible light of various wavelengths. The amount of reduction has been estimated by titrating ferrous ions against a standard solution of ceric sulphate. The effects of varying (1) the concentration of ferric chloride and that of aldehydes, (2) the temperature and (3) the hydrogen ion concentration of systems undergoing photochemical change, have also been examined. The order of the reduction is unimolecular under all circumstances.

39. Electro-deposition of chromium from potassium dichromate baths. Part IV. In presence of fluoride.

S. RAO *and* S. HUSAIN, Hyderabad (Deccan).

Electrolysis of potassium dichromate baths containing 0·1M to 0·2M potassium-hydrogen fluoride with a low current density at 40°C. gives dull white deposits, whereas those obtained from a potassium dichromate bath are bright. The current efficiency was 4 to 7%.

The presence of hydrogen ions is absolutely essential; a definite concentration of these must be maintained at the cathode. Too low or too high a current density is not favourable for chromium deposition.

40. The influence of non-electrolytes on cathode efficiency of copper deposition.

S. S. JOSHI, D. N. SOLANKI, *and* T. V. SUBHA RAO, Benares.

The effect of organic non-electrolytes—ethyl alcohol, methyl alcohol, acetone and glycerine—on cathodic efficiency of copper was studied quantitatively by electrolysis of a solution of copper sulphate (13% $CuSO_4$, $5H_2O$), acidified with sulphuric acid (about 4·4%), containing varying concentrations of the non-electrolyte. A steady current of 50 milli amp. was used for the electrolysis; the area of the copper cathode used was 10 sq. cm. The concentration of the non-electrolyte was varied up to 20% by volume. The cathodic efficiency is found to increase with the concentration of the non-electrolyte till a limiting value is reached for the mass of the copper deposited, further addition seems to have almost no further effect, though in the case of acetone there is a tendency for the value to diminish after the limiting value is reached. Though it is not clear as to how the addition of alcohols and other non-electrolytes affects the conditions of the bath, the increase in the mass of the Cu deposited (and also cathode efficiency) with the concentration of the nonelectrolyte can be best explained on the assumption that 'the alcohol decreases the concentrations of the copper ions and therefore the solubility of the copper in copper sulphate solutions, in close accord with the supposition of Forester and Siedel (*Zeit. anorg. Chem.*, *14*, 106, 1897).

41. Effect of colloids on the electro-deposition of nickel on copper.

V. S. PURI *and* V. S. BHATIA, Lahore.

The electro-deposition of nickel from nickel sulphate bath on copper plates in the presence of prussian blue, silver, ferric oxide and arsenious sulphide sols has been studied. A dull and very rough deposit is obtained in the presence of arsenious sulphide while the presence of other sols yields a comparatively lustrous and smooth deposit. The nature and concentration of the sol seem to affect the nature and amount of deposit.

42. The influence of alternating electric fields on the viscosity of colloids.

S. S. JOSHI *and* G. N. KADHE, Benares.

In the present work, the transpiration times for pure liquids flowing through a continuous capillary path of about 5 feet in length and subjected to alternating electric fields, disposed equatorially to the plane containing the capillary windings, were determined in an air thermostat under identical conditions, with and without the field. The viscosity was not sensibly affected in the case of pure liquids and aqueous electrolytes at different concentrations. A small but reproducible definite diminution was established in the case of colloids (different strengths of As_2S_3, Sb_2S_3, MnO_2, Fe_2O_3 and molybdenum blue). The effect was absent with stationary potentials for all the systems mentioned above; with A.C., it is more pronounced the greater the frequency of the applied field. The results are discussed in the light of the micellar charge, size, a postulated relaxation-time and other quantities partly from the standpoint of Debye-Hückel's theory.

43. Initiation of the photographic activity in the neighbourhood of gases subjected to electric discharge.

S. S. JOSHI *and* P. RAJU, Benares.

The action was investigated by exciting a given gas at a given pressure in the annular space of a glass ozoniser of the Siemen's type with the sensitive film in close vicinity from outside. It was observed that a minimum critical potential had to be applied to the gas, when alone the latent image is produced on the film. Detailed data are given for the variation of this pot potential, called the threshold potential in the case of air over a wide range of pressures, viz. 0·2 to 30 cm.Hg at two frequencies, of the electrical supply, viz. 50 and 500 cycles per second. The threshold potential was found to be sensibly a linear function of the gas pressure at a constant frequency. In numerous cases of chemical reactions produced under electrical stimulation as investigated in these laboratories, the threshold potential was found to be one of the principal determinants of the change; the present data suggest the need of extending the above concept to the occurrence of quasi-chemical reactions.

44. Studies in active nitrogen, part I.

S. S. JOSHI *and* A. PURUSHOTTAM, Benares.

Active nitrogen was obtained with a condensed, series-spark discharge in a Rayleigh tube actuated by an induction coil. Data are obtained in regard to the influence of heat from (*a*) liquid air temperatures to (*b*) 200°C., (*c*) 'the wall effect', (*d*) the effect of mercury vapour, and of (*e*) electrical fields. No sensible change in the intensity of the 'after glow' occurs on exposures to temperatures in the neighbourhood of (*b*). There is first a brightening followed by a quenching of the after glow at liquid air temperatures for which an explanation is suggested. Contrary to some views in the literature on the subject (*d*) and (*c*) were not found to be appreciably potent, the latter having been examined with uncontaminated materials. It is also observed that under certain conditions a marked spectral shift comes about in the 'after glow' on exposure to emissions from a heavy condensed discharge, the latter being optically screened from the seat of the after glow. This fact, indicative of a possible utilisability of active nitrogen in a coherer effect, does not appear to have been recorded hitherto in the already very extensive and rapidly growing literature on active nitrogen.

45. Behaviour of phosphine under electrical discharge.

S. S. JOSHI *and* R. KRISHNAN, Benares.

The behaviour of phosphine has been investigated for the spark and the silent electric discharge over a wide range of gas pressures and applied voltage. The course of the reaction and nature of the final products obtained under these conditions were found to be much more complex than what obtains in the thermal and the photochemical reaction. Free phosphine was not, in general, present after its exposure to the discharge for a reasonable time. Red-green-yellow coloured deposits and hydrogen were produced in the last stages, when the velocity of decomposition even under intense electric fields became very slow. The solid residue was found to be sensibly free of phosphorous. It is presumably a mixture of a number of hydrides of phosphorus, or perhaps of their adsorption complexes with hydrogen as a constituent. This last could be obtained by subjecting the coloured deposit to the discharge. This release of hydrogen, interestingly enough, occurred *per saltum*, corresponding to a series of synchronous discontinuities on the pressure-time and current-time curves. Essentially similar coloured products and discontinuities were obtained when free phosphorous was subjected to the discharge in an atmosphere of hydrogen at low pressures. The occurrence of any of the above reactions was found to be conditioned by the 'threshold potential'.

46. The decomposition of nitrous oxide under electric discharge.

S. S. Joshi *and* R. R. Gorey, Benares.

It has been observed during the studies on the progress of numerous chemical and quasi-chemical reactions, that a quantity called the 'threshold potential' represented the minimum value of the alternating electric field, which has to be exceeded in order to provoke chemical reactivity in the ionisation space. In experiments now reported the above decompositions were studied sensibly at the 'threshold potentials'. Under these conditions, as in zero order reactions, the amount of the change was found to be constant over a wide pressure range, viz. 11 to 50 cm.Hg, the frequency of the electrical supply being kept constant. The progress of a given decomposition at the 'threshold potential' showed at least two stages constituting the total change. During the first stage, which is comparatively short-lived, the rate of change was high; in the next stage, the above quantity got reduced very considerably. A study of the associated electrical quantities, such as the ionisation current, the energy dissipated in the reaction space during the change, etc. has shown the marked influence of nitrogen peroxide produced as an intermediate product, by reason of its high electron affinity.

Data are also given for the number of mols of N_2O decomposed per faraday under the discharge at different exciting voltages. This quantity increases with the voltage and then reaches a maximum; the efficiency decreases subsequently. Essentially, the remarks apply to the velocity of the change under the above conditions. Data are also given for the influence of temperature from 100°C. low down to the liquid air temperatures.

47. On theories of adsorption indicators.

S. G. Chaudhury *and* M. K. Indra, Calcutta.

The theories of Fajans and Kolthoff on the mechanism of the action of adsorption indicators in argentometric titrations have been shown to be untenable, by measuring the c.v. of the colloidal silver halide particles with and without the indicators, eosin, fluorescein and methyl violet, under the exact conditions of titration.

A new theory based on the conception of co-precipitation has been advanced. The main characteristic of this theory is that for an ideal titration (i) the solubility of the indicator compound (formed by combination of the indicator ion with either cation or anion as the case might be) should be equal to the solubility of the precipitate formed as a result of the reaction between the two precipitants, (ii) the activity of the indicator (i.e. indicator ion) taken should be equal to the activity of the anion or cation (as the case might be) in solution present after the precipitate (colloidal) is formed as a result of the reaction between equivalent quantities of the precipitants.

48. On hydrous oxide hydrosols and gels.

A. Ganguli, Chandernagar.

Freshly prepared sols and gels of hydrous oxides are truly amorphous. These consist of long chain complexes in accordance with the view of the author on the amorphous state developed in a previous paper. During the course of ageing and desiccation amorphous substances gradually pass to the polycrystalline and finally to the macrocrystalline forms.

Thixotropy, gelation, high viscosity, swelling of gels and X-ray structure find ready explanation on the above view.

49. Physico-chemical investigations on rice.

B. S. Rao, Bangalore.

From investigations carried out in this laboratory, it is concluded that rice is to be looked upon as a colloidal system intermediate between lyogel and a xerogel. During the last four weeks before harvesting of the paddy, syneresis takes place and water is exuded by rice. Application of 'Moist heat' at 60°–65°C. to freshly harvested paddy hastens the syneresis and promotes the xerogel state and a development of capillary spaces. Paddy treated in this way can be husked without causing disintegration of the rice grains and the rice obtained gives normal values for 'swelling'. Paddy is usually stored for three to six months before being husked. The physico-chemical changes that take place during this storage are discussed.

50. Activation of Fuller's earth.

B. S. Kulkarni *and* S. K. K. Jatkar, Bangalore.

Acting on our postulate that the activation of Fuller's earth is due to the formation of hydrogen zeolite in the body of the earth, we have studied the effect of electrodialysis and electrolysis on the Fuller's earth. From the results so far obtained, it has been noticed that the Fuller's earth is activated when subjected to such treatment and that the sodium contained in the original earth is removed and substituted by hydrogen. This method will obviate the very expensive method of activation by hydrochloric acid.

51. Influence of magnetic field on adsorption.

S. S. Bhatnagar, P. L. Kapur, *and* P. Sheel, Lahore.

Influence of magnetic field on the adsorption of $NiSO_4$, $MnCl_2$ and $KMnO_4$ by activated carbon has been studied. Increase in adsorption in the field has been observed in the case of $KMnO_4$ whereas decrease has been observed in the case of $NiSO_4$ and $MnCl_2$. Amount adsorbed in the magnetic field has been found to be influenced by the field strength as well. The results are in agreement with the results obtained by Bhatnagar *et al.* for the velocity of reaction in a magnetic field.

52. Adsorption by precipitates.

N. A. Yajnik, P. L. Kapur, *and* M. M. Singh, Lahore.

The adsorption of various ions ($\mathrm{Fe\ (CN)''''_6}$; $\mathrm{Fe(CN)'''_6}$; $\mathrm{CN'}$; $\mathrm{NO'_3}$; $\mathrm{ClO'_3}$; $\mathrm{MnO'_4}$; $\mathrm{SO''_4}$; $\mathrm{IO'_3}$; $\mathrm{Cl'}$; $\mathrm{Br'}$; $\mathrm{I'}$) by the precipitated hydroxides of copper, bismuth, zinc and magnesium has been studied.

From the results of the present series of investigations, we find the order of adsorption of various ions expressed in milli-moles per gm. of the adsorbent is :

(i) For copper hydroxide :

$\mathrm{SO''_4 > ClO'_3 > NO'_3 > CN' > Br' > Cl' > I' > MnO'_4 > IO'_3}$

(ii) For bismuth hydroxide :

$\mathrm{CN' > Cl' > Br' > I' > NO'_3 > IO'_3 > SO''_4 > MnO'_4 > Fe(CN)''''_6 > Fe(CN)'''_6}$

(iii) For zinc hydroxide :

$CN' > SO''_4 > NO'_3 > MnO'_4 > IO'_3 > Fe(CN)''''_6 > Cl' > Br' > I' > Fe(CN)'''_6$.

(iv) For magnesium hydroxide :

$SO''_4 > NO'_3 > CN' > Fe(CN)'''_6 > Fe(CN)'''_6$

In general the order of the adsorptive power is

$Zn(OH)_2 > Bi(OH)_3 > Cu(OH)_2 > Mg(OH)_2$.

53. Neutral salt effect on the adsorption of acids by charcoal.

H. K. ACHARYA *and* N. K. RAY, Calcutta.

The adsorption by activated sugar charcoal and commercial charcoal of hydrochloric, benzoic, salicylic, succinic, malic, tartaric, nitrobenzoic, benzol sulphonic and citric acids from their 0·01N solutions in absence and in presence of different concentrations of NaCl and $BaCl_2$ has been studied. The pH values of the acid solutions before and after adsorption have been compared and also those of acid solutions having the same concentration as the end concentraiton of the acids and containing the salts in the same concentration as used in the adsorption experiments have been measured.

It has been found that the adsorption of the acids increases regularly with increasing concentration of the salts, NaCl being more effective than $BaCl_2$. The adsorption of the acids in the absence of the salts and the relative increment in their presence are greater for the commercial charcoal than those for the sugar charcoal. The relative increment in adsorption depends, however, on the adsorbability of the acids. The adsorbability of the acids studied lies in the order : benzoic > salicylic > succinic > malic > tartaric > nitrobenzoic > benzosulphonic > citric acid.

The results have been discussed on the basis of the variation of the pH values of the solutions and also on the neutral salt effects on the activity, solubility, hydration and surface tension of the acid solutions.

54. On the nature of inter-micellary liquids.

S. K. CHAKRABERTTY, D. N. GHOSH, *and* P. B. GANGULY, Patna.

Colloidal solutions of silver, copper, arsenic sulphide, aluminium hydroxide and vanadium pentoxide were prepared. Each of the solutions was filtered free from particles by means of a membrane ultra-filter and also by electro-dialysis. The pH of the original colloids and also of the inter-micellary liquids obtained by the above processes were carefully measured. A glass electrode was used, the potential being fed to the grid of a 'pleotron' space charged tube and measured with the help of a Tinsley potentiometer. In another series of experiments small amounts of acid were added to the colloid and the pH of the acidified sol and the inter-micellary liquids were again determined. In every case a small but distinct change was observed. The results are discussed in the light of previous work on the subject by Mukherji and by Pauli.

55. 'Zonal effect' in the variation of opacity during electrolytic and mutual coagulations of colloid arsenious sulphide and ferric hydroxide.

S. S. JOSHI *and* KRISHNA CHANDRA, Benares.

It has been established by the senior author, from viscometric and opacity measurements, that contrary to the mechanism contemplated by Smoluchowski in his classical theory for the kinetics of coagulation, this change is not time-continuous, but proceeds 'zonally', at any rate in the slow region. The data in the present paper confirm the above finding employing the method of measuring change of opacity for both monochromatic and white light for slow coagulations of the above sols, which have had perhaps the longest usage in the studies of these phenomena, the turbidity opacity test being the oldest criterion of the occurrence of the coagulation.

56. Ageing of surfaces of solutions III. Effect of concentration on activated accumulation of solute molecules at surfaces of solutions.

K. S. GURURAJA DOSS, Bangalore.

The effect of concentration on the rate of activated accumulation at the surfaces of solutions has been studied. The results indicate (1) that the solute molecules at the surface are probably whipping and whirling about whenever there is free space available, and (2) that the benzopurpurin molecules tend to get associated at higher concentrations.

The significance of certain new features of the surface tension-time curves of the more dilute solutions has been discussed.

57. Studies on the formation of periodic precipitates—PbI_2 rings in agar and condition of PbI_2 when precipitated in presence of agar.

R. B. DALELA *and* A. C. CHATTERJI, Lucknow.

Formation of lead iodide rings in agar gel of different brands has been studied.

The regularity and the prominence of the rings increased as the concentration of the lead iodide decreased while concentration of the diffusing electrolyte remained the same.

The distance between two consecutive rings at an equal distance from the top increased as the concentration of the diffusing electrolyte was decreased.

Amount of lead iodide present as ions has been calculated at different concentrations varying from N/500 to N/50 in agar, gelatine and water (from electric conductivity experiments). A comparison of these results indicates that the condition in which lead iodide is present in agar and gelatine when freshly formed so long as the solution is colourless is not materially different from that in water. In other words agar and gelatine do not show any indication of possessing any special power of inducing supersaturation.

The percentage of lead iodide present as ions is slightly greater in gelatine than in agar. This may be due to the more acidic nature of gelatine gel (pH 5·4–5·7) than that of the agar gel (pH 6·25).

58. Investigations on stearic acid hydrosols.

S. MUKHERJEE, Calcutta.

The interactions of colloidal solutions of stearic acid with bases, neutral salts and hydrolysable salts have been studied. The titration curves of the sols with $Ca(OH)_2$ and $Ba(OH)_2$ are similar. After an initial rise the pH remains unchanged over a range and finally shows a sudden rise. The total acidity calculated at the inflexion point agrees with the analytical concentration of the acid. Titration curves with NaOH resemble that of a weak monobasic acid and the final inflexion point occurs at the neutralization point. Using NH_4OH the final inflexion does not appear. Calculations of buffer capacity show a departure from the behaviour of a weak acid in true solution.

The hydrogen ion activity of the sol increases on interaction with $BaCl_2$ and $CaCl_2$ and very slightly with KCl.

The results have been shown to correspond to the behaviour of a heterogeneous system. Ba++ or Ca++ ions are adsorbed on the stearate ions on the surface of the particles to form ion pairs which subsequently split off and form separate solid phases. The whole of the acid is thus enabled to react. The particles gradually dissolve on interaction with NaOH or NH_4OH. The special features of the variations in the buffer index during titration with alkali met with in such systems have been discussed.

59. The electrochemical properties of electrodialysed silicic acid sols.

B. Chatterjee, Calcutta.

The changes produced by electrodialysis on the electro-chemical properties of silicic acid sols, purified by prolonged dialysis, have been studied. In contrast to the observations of Rabinowitsch and Kargin (Trans. Faraday Soc., *31,* 1935), the acidic character of silicic acid sols does not vanish on electrodialysis; on the contrary the electrodialysed sols, although having lower silica contents, have lower pH values and show stronger acid character. The titration curves of electrodialysed sols with dilute bases have sharper inflexion points. It has been shown that the changes in the nature of the titration curves, brought about by electrodialysis, are not due to the effect of dilution. Titration curves of the electrodialysed sols with NaOH and $Ca(OH)_2$ solutions show points of inflexion at the same concentrations of added bases but the NaOH curve is steeper in the corresponding regions than the $Ca(OH)_2$ curve. A considerable amount of acid is liberated by the action of neutral salts on electrodialysed silicic acid sols, the effects of Ba++ and Ca++ being practically the same. The ultrafiltrates of the electrodialysed sols are practically neutral. It is shown that silicic acid sols do possess acid character due to mobile hydrogen ions in the double layer associated with the colloidal particles.

60. Discrepancies between conductivity and activity measurements with colloidal solutions of hydrogen clays.

R. P. Mittra, Calcutta.

Marked discrepancies have been observed between the actual specific conductivities of colloidal solutions of hydrogen clays and those calculated from their activity data. The actual conductivity is even less than that due to the hydrogen ions alone calculated from their activity determined by electrometric measurements using glass and hydrogen electrodes in conjunction with calomel half elements. These hydrogen ions, therefore, though registering their activity on the above reversible electrodes, do not take part in the conduction of electricity in the usual manner. This observation shows an anomalous difference between the conductivity and activity coefficients.

61. Change in the absorption limit during the electrolytic coagulation of colloid manganese dioxide.

A. Purushotham, Benares.

Following a previous observation, we have examined the changes in the absorption spectrum during the coagulation of colloidal MnO_2 with particular reference to the use of mercurous sulphate as a coagulant and obtained well marked changes in the absorption band in the visible. It was observed that the shift during coagulation occurred, in the main, in the short wave region. The absorption limit on the red side was observed to be sensibly constant during a number of coagulations. Details are given for the variation of the range of absorption as a function of the colloid and coagulant concentrations and like factors.

Organic and Biochemistry

62. A study of the velocity of decomposition of some aliphatic cyanides.

D. D. GHARPURE *and* D. D. KARVE, Poona.

The velocity of the decomposition of acetonitrile, propionitrile, butyronitrile, and normal and iso-valeronitrile by sulphuric acid at 50°C has been determined. The proportion of amide and ammonium salt formed has been estimated separately and the effect of changes of concentration of the acid has also been studied.

63. Velocity of hydrolysis of butyl acetate and iso-amyl acetate in heterogeneous systems.

V. L. MEHENDALE *and* D. D. KARVE, Poona.

The hydrolysis of the above two esters dissolved in xylene and toluene by aqueous hydrochloric acid has been studied with respect to the effect of factors like speed of shaking, concentrations of the reacting substances, etc. The general conclusion reached is that these reactions take place mainly at the surface of contact, though owing to the liberation of the butyl and iso-amyl alcohols a slight proportion of the ester dissolves in the aqueous phase and a homogeneous reaction also takes place simultaneously.

64. Velocity of hydrolysis of some aromatic acid chlorides in heterogeneous systems.

K. K. DOLE *and* D. D. KARVE, Poona.

In continuation of previous work on the hydrolysis of benzoyl chloride (Karve and Dole, *Proc. Ind. Sc. Cong.*, 1937) the following acid halides have been investigated :

o-chloro-, *m*-chloro-, *o*-bromo-, *o*-ido-, *o*-nitro- and *m*-nitrobenzoyl chlorides, cinnamoyl chloride, phthalyl chloride and benzoyl bromide.

The following acid chlorides in which the solid acid separates out as a third phase have also been studied :

p-chloro-, *p*-bromo-, *p*-nitro-, 3·5-dinitro-benzoyl chlorides and anisoyl chloride.

From a detailed study of these heterogeneous reactions, it has been concluded that in most of these reactions the heterogeneous part of the reaction predominates and the homogeneous part, due to the very slight solubility of the acid chlorides in water, is negligible.

65. Synthesis and resolution of α-ethoxy stearic acid.

(MISS) P. DEVI *and* P. RAMASWAMI AYYAR, Bangalore.

This substance figuring in the title has been prepared in 80 per cent yield by the action of sodium ethoxide on α-bromo-stearic acid derived from natural stearic acid. It melts at 58-59°C and, after resolution by means of brucine, the dextro-isomer has $(\alpha)\ 25° = +9{\cdot}7°$.

66. Synthesis of αβ-eicosenoic acid.

(Miss) P. Devi *and* P. Ramaswami Ayyar, Bangalore.

By the action of sodium ethoxide on α-bromo-eicosanic acid derived from natural eicosanic acid, one isomeric form of the above acid (m.p. 64-65°C) is formed in about 15 per cent. yield. The main product is α-ethoxy-eicosanic acid (m.p. 62-63°C ; ethyl ester m.p. 23-24°C).

67. Relations between chemical activity and absorption in the ultra-violet of the chloro derivatives of the amides of malonic acid.

Mme. Ramart, K. G. Naik, *and* C. M. Mehta, Baroda.

In the present study it is expected to throw some light on the relationship between the chemical activity of the chloro derivatives of the various substituted amides of malonic acid, of the type : $Cl_2 : C : (CONHR)_2$, $Cl_2 : C : (CONH_2).(CONHR)$, and $(Cl)\ (ClCH_2) : C : (CONHR)_2$, where R is phenyl, tolyl, etc. groups.

The following chloro derivatives were examined in the ultra-violet and their absorption spectra were obtained.

(1) Dichloromalon-di-phenylamide, (2) Dichloromalon-di-*o*-tolylamide, (3) Dichloromalon-di-*p*-tolylamide, (4) Dichloromalon-di-*m*-tolylamide-dichloride, (5) Dichloromalon-di-1 : 3 : 4-xylidide, (6) Dichloromalon-di-heptylamide, (7) Dichloromalon-di-benzylamide, (8) Dichloromalon-mono-*p*-tolylamide, (9) Dichloromalon-monochloro-phenylamide, (10) Chloromethyl chloromalon-di-phenylamide, (11) Chloromethyl chloromalon-di-*o*-tolylamide, (12) Chloromethyl chloromalon-di-*p*-tolylamide.

The results of absorption spectra of the above compounds have been compared with the absorption spectra measurements of the compounds of the type $H_2 : C : (CONHR)_2$ studied by Ramart, Naik and Trivedi (*Bull. Soc. Chim.*, 1934, p. 525).

The comparison of these two corresponding sets of curves shows that the transformation of methylene group $\text{-}CH_2\text{-}$ into $\text{-}CCl_2\text{-}$ group produces a distinct change in the nature of the curves.

1. The principal band in the methylene compounds is more steep and narrow and its crest is situated between the frequency 1200 and 1300 ; whereas in the case of the chloro derivatives the band becomes broad and shallow and the crest of the principal band is situated between 1100 and 1200.
2. The secondary band in the case of methylene derivatives is feebly marked and is situated between the frequencies 1000 and 1100. This secondary band due to the presence of CH_2 group has disappeared in the chloro derivatives, where the CH_2 group is transformed into $\text{-}CCl_2\text{-}$ group.
3. It is observed that the general absorption increases as we pass from ortho to para derivatives. The bands of absorption are shifted towards the visible region in the following order : Ortho meta para.
4. The curves representing the absorption of dichloromalon-diphenylamide and malon-di-phenylamide show a peculiar tendency to cut the curves representing their tolyl derivatives.

68. The velocity of saponification of the chloro derivatives of the substituted amides of the malonic acid of the type : $Cl_2 : C : (CONHR)_2$, $Cl_2 : C : (CONH_2)\ (CONHR)$ and $(Cl)\ (ClCH_2) : C : (CONHR)_2$, where R is phenyl, tolyl, etc. groups.

K. G. Naik, R. K. Trivedi, *and* C. M. Mehta, Baroda.

In order to investigate chemical activity of the chloro compounds as expressed by their velocity of saponification, the following compounds were selected for study :—

(1) Dichloromalon-di-phenylamide, (2) Dichloromalon-di-*p*-tolylamide, (3) Dichloromalon-di-*m*-tolylamide dichloride, (4) Dichloromalon-di-*o*-tolylamide, (5) Dichloromalon-di-1 : 3 : 4-xylidide, (6) Dichloromalon-di-heptylamide, (7) Dichloromalon-di-propylamide, (8) Dichloromalon-mono-*p*-tolylamide, (9) Dichloromalon monochloro phenylamide, (10) Chloromethyl chloromalon-di-phenylamide, (11) Chloromethyl chloromalon-di-*p*-tolylamide, (12) Chloromethyl chloromalon-di-*o*-tolylamide.

The above compounds were made to react with standard alcoholic potash solution and titrated with standard hydrochloric acid at regular intervals. The results were tabulated in the form of curves representing the time as abscissa and the percentage of the compound saponified as ordinate.

In compounds (2), (3) and (4) the augmentation of the velocity of saponification proceeds as ortho meta para. This could be explained if we were to assume that in solution the substances exist in a condition of equilibrium expressed in the following way : RNH. CO.CH : C : (OH) (NHR) RNH.CO.CH_2.C (: NH) (OH) R.NH.CO.CH_2.CO.NHR.

The velocity of saponification depends upon the nature of the radical attached to the saponifiable imino -NH- grouping. It also depends upon the position of the methyl group with regard to the saponifiable imino group.

69. The velocity of reduction of the chlorines substituting the hydrogens of the reactive methylene group -CH_2- in the compounds of the type Cl_2 : C : $(CONHR)_2$, where R is phenyl, tolyl, etc. groups.

K. G. Naik, R. K. Trivedi, *and* C. M. Mehta, Baroda.

The velocity of reduction of the chlorine atoms was studied by treating the following compounds by means of hydriodic acid generated through the action of HCl on KI (Kurt Meyer, *J.C.S.*, 1921, *119*, 951, 305).

(1) Dichloromalon-di-phenylamide, (2) Dichloromalon-di-*p*-tolylamide, (3) Dichloromalon-di-*m*-dichloro-tolylamide, (4) Dichloromalon-di-*o*-tolylamide, (5) Dichloromalon-di-1 : 3 : 4-xylidine, (6) Dichloromalon-di-*b*-dichloronaphthylamide, (7) Dichloromalon-di-heptylamide, (8) Dichloromalon-di-propylamide, (9) Dichloromalon-di-benzylamide, (10) Dichloromalon-monochlorophenylamide, (11) Dichloromalon-mono-*p*-tolylamide, (12) Chloromethyl chloromalon-di-phenylamide, (13) Chloromethyl chloromalon-di-*p*-tolylamide, (14) Chloromethyl chloromalon-di-*o*-tolylamide.

The velocity of reduction of chlorines was represented by obtaining the curves by plotting the time of heating along the abscissa and the percentage reduced along the ordinate. It was observed from the nature of the curves of the above compounds that the velocity of reduction goes on increasing in series from compounds (1) to (5). This is attributed to the nature of the groups attached to the carbonyl groups between which the CCl_2 complex is situated as well as to the insertion and the position of the methyl groups in the phenyl nucleus. In each case the velocity of reduction is considerably lowered when fifty per cent. of the total chlorine is reduced.

The curves of the compounds (7), (8) and (9) indicate that when the radicals attached to the carbonyl group carry aliphatic chain the velocity of reduction is increased. If the chain is shorter the velocity of reduction is decreased.

The compounds (10) and (11) show a drop in the velocity of reduction which is due to the presence of only one heavy radical in the complex.

The remarkable decrease in the velocity of reduction of the compounds (12), (13) and (14) is attributed to the presence of the -$ClCH_2$- grouping.

70. Interaction of phenylhydrazine with the halogen derivative of the substituted amides of malonic acid.

K. G. Naik, R. K. Trivedi, *and* C. M. Mehta, Baroda.

In order to study the labile nature of the chlorine atoms substituting the hydrogens in the reactive methylene group -CH_2-, the interaction of phenylhydrazine with the compounds mentioned below was investigated.

(1) Dichloromalon-di-phenylamide, (2) Dichloromalon-di-*o*-tolylamide, (3) Dichloromalon-di-*p*-tolylamide, (4) Dichloromalon-di-1 : 3 : 4-xylidide, (5) Dichloromalon-di-*m*-dichloro-tolylamide, (6) Dichloromalon-mono-chlorophenylamide, (7) Dichloromalon-mono-*p*-tolylamide, (8) Chloromethyl chloromalon-di-*o*-tolylamide, (9) Chloromethyl chloromalon-di-*p*-tolylamide.

All the above compounds reacted with phenylhydrazine yielding their respective hydrazone derivatives. The compounds (1), (2), (3) and (4) gave rise to the general type $C_6H_5NHN : C : (CONHR)_2$, while compounds (5) and (6) reacted with phenylhydrazine yielding the compounds in which the chlorines in the nucleus remained unaffected.

The compounds (8) and (9) reacted with phenylhydrazine in a similar way giving a three-membered ring (N-anilino ethylenimide dicarboxylanilide).

All the above hydrazone compounds are found to be very stable and resist boiling with water and alcohol.

71. The additive reactivity of olefines. Part I. Some preliminary observations on the addition of cyanoacetamide and malonic ester to $\alpha : \beta$ unsaturated ketones.

S. V. Anantakrishnan *and* Chittaranjan Barat, Calcutta.

The influence of substituents on the additive reactivity of the ethylenic linkage of $\alpha : \beta$ -unsaturated ketones has been discussed in the light of theories developed by Ingold and co-workers. The ratio of the velocity constants in the addition re-reaction between such ketones and cyanoacetamide have been calculated from the yields on the assumption of a bimolecular reaction and this ' reduced velocity ' has been used for purposes of comparison.

72. Action of sodium acetate and acetic anhydride on β-aryl-glutaconic acids.

G. R. Gogte, Bangalore.

By the action of acetic anhydride and fused sodium acetate, at higher temperatures, β-(2-methoxy-5-methyl-phenyl)-glutaconic acid gives a compound, m.p. 168° C. ($C_{17}H_{16}O_6$). This is supposed to be a glutaconyl acetic acid of the C-acetyl-β-(2-methoxy-5-methyl-phenyl) -glutaconic anhydride, m.p. 126°C., as it can be synthesized from the latter by the action of acetic anhydride and fused sodium acetate. Further this compound, m.p. 168°C. gives a neutral oil by the action of hydrochloric acid, which when hydrolysed by caustic alkali, furnished the ketonic acid, m.p. 101°C. (decomp.) (described in an earlier abstract). By the action of caustic alkali, this compound, m.p. 168°C, produced a hydroxy-acid, m.p. 212°C. (decomp.) ; a neutral product, m.p. 82°C. and two acids m.p. 177°C. (decomp.) and 170°C.(decomp.). The constitutions of these products are under investigation.

73. C-acylation of β-aryl-glutaconic anhydrides.

G. R. Gogte, Bangalore.

By the action of acetyl chloride and pyridine, β-(4-methoxy-phenyl)-glutaconic anhydride (m.p. 160°C) has been found to give an acetyl derivative, m.p. 130°C. The C-acetylation here has been proved by the transformation of this derivative into a ketonic acid, m.p. 125°C (decomp.), which was found identical with the one described by Limaye and Bhave (*J. Univ. Bombay*, 2, part II, 82). The derivative titrates as a monobasic acid (*cf.* C-acetyl-acetoacetic ester) and gives violet ferric reaction. β-(2-methoxy-5-methyl)-phenyl glutaconic anhydride (m.p. 117°C) gives a similar C-acetyl derivative, m.p. 126°C, from which a ketonic acid, m.p. 101°C (decomp.), has been isolated. The neutral ketone b.p. 177°/36 mm. obtained by decarboxylating this ketonic acid, gave, on oxidation with hypobromite, 2-methoxy-5-methyl-β-methyl-cinnamic acid, m.p. 111°C, which again was transformed into 4 : 6-dimethyl coumarin, m.p. 148-49°C, by the action of concentrated sulphuric acid.

The action of benzoyl chloride and pyridine on β-aryl-glutaconic anhydride is under investigation.

74. Halogenation, Part XXII. Chlorination and bromination of toluene under the combined influence of sunlight and halogen carriers.

P. S. Varma, (Mrs.) P. Annapurna S. Rao, *and* A. Krishnamurthy, Benares.

Chlorination and bromination of toluene have been carried on exhaustively in sunlight alone or in the dark or in sunlight in presence of substances such as lithium bromide, beryllium oxide, sodium chloride, magnesium powder, magnesium bromide, aluminium dust, aluminium chloride, aluminium-mercury couple, red and yellow phosphorus, phosphorus pentachloride, phosphorus trichloride and tribromide, sulphur, chromic acid, manganese chloride, potassium permanganate, iron, ferric chloride and bromide, nickel bromide, cuprous and cupric chloride, finely divided copper, zinc dust, arsenic trichloride, selenium, bromine, yttrium nitrate, zirconium nitrate and oxide, molybdic acid, freshly precipitated silver oxide, antimony and antimony trichloride, iodine, lanthanum chloride, didanium nitrate, cerium chloride, mercury and red oxide of mercury, thorium oxide and chloride and uranium nitrate, etc.

On account of their effect on chlorination and bromination, the above substances can be divided into the following four groups :—

1. Those that have no effect at all on chlorination and bromination, i.e. the products obtained being the same as those obtained in sunlight alone.
2. Those that facilitate the production of only *p*-substituted nuclear compounds with a certain quantity of the side-chain substituted halogen derivatives.
3. Those that produce both *o*- and *p*-substituted nuclear compounds, the *p*-substituted derivative predominating in some cases and the *o*-substituted one in others.
4. Those that induce both *o*- and *p*-substituted nuclear derivatives as well as side-chain substituted ones.

Results obtained in chlorination and bromination are not identical, there being considerable differences in the nature of the products obtained in the two cases.

75. γ-Substitution in the resorcinol nucleus, Part II. The Gattermann reaction on resacetophenone.

H. A. Shah *and* R. C. Shah, Bombay.

Resacetophenone does not undergo the Gattermann reaction under the usual conditions. However, the application of the modified method of Shah and Laiwalla (*Ind. Sci. Cong. Abst.*, 1937, 24; *Current Sci.*, 1936, 197) for the introduction of the aldehydo group in the γ-position into methyl β-resorcylate, was successful. The Gattermann reaction thus carried out with aluminium chloride dissolved in dry ether as solvent, gave a high yield of the ketone-aldehyde 2 : 4-dihydroxy-3-aldehydo-acetophenone (I), the aldehydo group entering the γ-position, as in the case of methyl-β-resorcylate. Various derivatives and related compounds have been prepared from (I). Synthesis of coumarino-chromones and similar heterocyclic compounds from (I), which appears to be well adapted for this purpose, is under progress.

2-acetyl resorcinol by the modified Gattermann reaction gives the corresponding aldehyde, 2 : 4-dihydroxy-3-acetyl-benzaldehyde.

76. γ-Substitution in the resorcinol nucleus, -Part III. Synthesis of 2-benzoyl-resorcinol.

V. R. Heeramaneck *and* R. C. Shah, Bombay.

Benzanilide imidochloride reacts with methyl-β-resorcylate in the presence of aluminium chloride to give the anil-hydrochloride of methyl-2 : 4-dihydroxy-3-benzoyl-benzoate (I) which on treatment with alcoholic HCl gives methyl-2 : 4-dihydroxy-3-benzoyl-benzoate (II). (II) on hydrolysis with cold alkali gives the corresponding free acid (III) which on decarboxylation afforded *p*-benzoyl-resorcinol (IV), m.p. 135°C. (IV) is also obtained directly from (II) by boiling with alkali, hydrolysis and decarboxylation taking place in one stage. Limaye has previously synthesized (IV), m.p. 136°C, by the action of alkali on 7-hydroxy-4-methyl-8-benzoyl-coumarin (*Ber.* 1934, *61*, 12).

77. On anacardic acid, Part III.

P. Parameswaren Pillay, Trivandrum.

Anacardic acid, the chief constituent of the pericarp of the Cashewnut has a salicylic acid fragment with a long straight $C_{15}H_{27}$ side chain in the ortho-position to the carboxyl. The acid was reduced with sodium and alcohol and also distilled with zinc. Nitration, oxidation with hydrogen peroxide, the effect of heat on its ammonium salt and the condensation induced by thionyl chloride, were also studied.

78. Synthesis of ortho-cyanaldehydes, Part I.

S. N. Chakravarti *and* K. Ganapati, Agra.

Attempts to synthesize ortho-cyanaldehydes, none of which have yet been synthesized, from the corresponding *o*-amino-aldehydes, *o*-amino-aldoximes, *o*-amino-acetals and *o*-amino Schiff's bases through the aid of Sandmeyer's reaction were all unsuccessful. During the course of these experiments an excellent method of preparing *o*-amino-aldoximes was discovered. *O*-amino-aldoximes can be diazotised in concentrated hydrochloric acid solution.

O-cyanaldehydes can be readily synthesized but only in poor yields by the oxidation (with permanganate) of the corresponding *o*-cyan-cinnamic acids which are readily obtainable by synthesis. During these oxidations a high melting substance is always formed in every case as a main product. These substances are being investigated.

3-methoxy-6-cyan-benzaldehyde, m.p. 107°C, and *o*-cyanbenzaldehyde, m.p. 76°C, were synthesized by this method.

79. Halogenation, Part XXI. Direct replacement of sulphonic groups in aromatic hydrocarbons by chlorine atoms.

P. S. VARMA, N. B. PAREKH, *and* V. K. SUBRAMANIAN, Benares.

It has been possible to replace directly sulphonic groups by chlorine in aromatic hydrocarbons by heating the aromatic hydrocarbon sulphonic acids strongly with cuprous or cupric chloride and thus chloro-benzene from benzene sulphonic acid, *p*-chloro-toluene from *p*-toluene-sulphonic acid, *o*-chloro-toluene from *o*-toluene sulphonic acid, *p*-nitro-chloro-toluene from *p*-nitro-toluene sulphonic acid, *p*-chloro-*o*-nitro-toluene from *o*-nitro-toluene sulphonic acid, *m*-nitro-chloro-benzene from *m*-nitro-benzene sulphonic acid, trichloro-benzene from dichloro-benzene sulphonic acid, α-chloro-naphthalene from naphthalene-α-sulphonic acid, β-chloro-naphthalene from naphthalene-2-sulphonic acid and 6 : 8-dichloro-2-naphthylamine from 2-naphthylamine 6 : 8-disulphonic acid have been obtained. By a similar process bromo derivatives of aromatic hydrocarbons have also been prepared.

80. Studies in chloral amides: chloral-amide of 3-amino-salicylic acid.

N. W. HIRWE *and* M. A. WAGH, Bombay.

3-acetylamino-salicylamide was condensed with chloral to the corresponding chloral amide. Acetyl and benzoyl derivatives were prepared. Sulphuric acid did not dehydrate this compound to an oxazine derivative, as in the case of 5-amino acid, but the same was obtained when the chloral amide was treated with acetic anhydride in an alkaline medium. The compound could not also be hydrolysed with aqueous ammonia into an α-amino-chloral-3-amino-salicylamide.

81. Studies in chloral amides: Chloral amide of 5-amino-salicylic acid.

N. W. HIRWE *and* K. N. RANA, Bombay.

5-acetylamino-salicylamide was condensed with chloral, giving the corresponding chloral-amide. Various derivatives, such as acetyl, benzoyl and methoxy, of this chloral-amide have been prepared. It gave a meta-oxazine compound on dehydration with concentrated sulphuric acid. The oxazine compound on treatment with acetic anhydride gave an acetyl derivative suggesting the presence of a tautomeric hydrogen ; hydrochloride of the oxazine could not be obtained, thus confirming the existence of the hydroxy group. Attempts were made to break the oxazine ring at the oxygen-linkage with a view to obtain an α-amino group by hydrolysis with strong ammonia: shaking with liquor ammonia (D. 0·888) had no effect, but on heating the molecule hydrolysed to give the starting acid ; on passing a current of ammonia in a warm alcoholic solution of the substance a base was obtained, the hydrochloride of which analysed as $C_{30}H_{40}O_{10}N_7Cl_4$.

Further work is in progress.

82. Nitration of *m*-methoxy-cinnamic acid.

S. N. CHAKRAVARTI, K. GANPATI, *and* S. ARAVAMUDHACHARI, Agra.

4-nitro-3-methoxy-cinnamic acid, m.p. 296°C, is formed as the main product of nitration of *m*-methoxy-cinnamic acid. The constitution of the nitro compound was established by its oxidation to 4-nitro-4-methoxy-benzaldehyde and 4-nitro-3-methoxy-benzoic acid, and by synthesis. The formation of 4-nitro-3-methoxy-cinnamic acid as the main product of nitration is a matter of considerable interest and is rather anomalous and contrary to the expectations of the current theories.

6-nitro-3-methoxy-cinnamic acid, m.p. 227°C and 2-nitro-3-methoxy-cinnamic acid m.p. 265°C which were also formed as bye-product during the nitration were also synthesized. All the corresponding hydroxy nitrocinnamic acids have also been synthesized, which, curiously enough, all melt lower than the corresponding methoxy compounds.

During the course of these investigations it was found that much of the older work on nitration of *m*-hydroxy-cinnamic acid and 3-methoxy-cinnamic ester requires revision and correction.

83. The condensation of aldehydes with amides, Part I. The condensation of salicylaldehyde.

K. C. PANDYA *and* S. T. SINGH, Agra.

Condensations of aldehydes with amides have been studied by a large number of workers, in some cases with the help of catalysts, in others without them. No attempt appears to have so far been made to observe whether the catalyst could be traces of organic bases, like pyridine, found so very useful in condensations of aldehydes with malonic acid by Pandya and co-workers. Nor has any one apparently studied the possibility of condensations of salicylaldehydes in this manner.

It has been shown in this paper that salicylaldehyde condenses with formamide, acetamide, benzamide and phenyl-acetamide, equally well, when the sodium acetate of earlier workers (Cebrian, *Ber.* 1898, *31*, 1592 ; Titherley and Harples, *J.* 1908, *93*, 1933) is replaced by any of the usual organic bases in traces, or even when no base is used at all. The products obtained here are identical with those reported by earlier workers, but are much cleaner (*cf.* Gupta, *J.*, 1921, *119*, 298). The earlier workers have not mentioned yields, but a comparison has been made by repeating their experiments, when it is found that the yields in the present case are not only very much higher, but are occasionally quantitative.

The structures of the resulting compounds are discussed.

84. The condensation of aldehydes with amides, Part II. Condensation of cinnamaldehyde.

R. K. MEHRA *and* K. C. PANDYA, Agra.

There is only one condensation so far reported, and that is of this aldehyde with phenylacetamide by Gupta (*J.*, 1921, *119*, 298), who by merely heating the two together for 2 hours at 160–170°C obtained cinnamylidene-bis-phenylacetamide. The yield is not mentioned, but on repeating his experiment, the authors obtained an yield of about 15% only. It increased slightly only, to 18%, when a trace of pyridine was used as a catalyst. In condensations with acetamide and with benzamide, suitable alterations in the conditions of the experiments improved the yield, which came up to about 50%. Analysis showed the products to be of a similar composition to above.

Condensations with formamide gave a product in very good yield, but the exact composition of it is under investigation.

Propionamide also condenses well.

85. The condensation of aldehydes with malonic acid in the presence of organic bases, Part X. The condensation of resorcylaldehyde.

K. C. Pandya *and* S. T. Singh, Agra.

The condensation of aromatic aldehydes with malonic acid in the presence of organic bases in traces has been found to be often affected by the presence of a hydroxy group in the nucleus, particularly in the ortho-position (*vide* earlier papers, *Proc. Ind. Acad. Sci.* and *Proc. Ind. Sci. Cong.*). In the present case of resorcylaldehyde, 2 : 4-dihydroxybenzaldehyde (I), there is an aromatic aldehyde with two hydroxy groups, and one of them is in an ortho position to the aldehyde group.

Resorcylic aldehyde condensed with malonic acid in the presence as well as in the absence of an organic base in traces, though the product in the first case was umbelliferone and in the latter case was umbellic acid (2 : 4-dihydroxy-cinnamic acid). The yields, however, were small, ranging between 24 and 37%. This may be due to the presence of a second hydroxy group, as was expected.

86. The condensation of aldehydes with malonic acid in the presence of organic bases, Part IX. The condensation of β-hydroxynaphthaldehyde or 2-hydroxy-naphthaldehyde—(I).

K. C. Pandya *and* T. A. Vahidy, Agra.

In the earlier papers on the study of the condensation of aromatic aldehydes with malonic acid in the presence of organic bases, a diminished yield of the condensation product has often been observed when a hydroxyl group has been present in the benzene ring, particularly in the ortho-position. 2-hydroxy-naphthaldehyde was prepared from β-naphthol by the well known modification of Gattermann's method, and the condensation with malonic acid in the presence of traces of pyridine, lutidine and α-picoline was found, on heating at 105–110°C for six hours, to give almost quantitative yields. Even when no base was used, the condensation took place and gave, under the conditions described above, over 60% yield.

It appears therefore that in a naphthalene ring, in the position 2 : 1, the hydroxy group does not exert the same obstructive influence as it does in salicylaldehyde.

The product in all the above cases was 5 : 6-benzocoumarin-carboxylic acid, m.p. 81°C, while by Perkin's method benzocoumarin and small amounts of β-naphthyl-acrylic acid have been obtained by other workers.

87. Oxidation of naphthalene in the vapour phase.

J. K. Chowdhury *and* M. A. Saboor, Dacca.

Naphthalene has been oxidised with air in the presence of different catalysts. Mixed oxides of tin and vanadium have given the best results in the oxidation of naphthalene to phthaleic anhydride under the following conditions :—

Diam. of catalyst tube (glass)	1·5 cm.
Catalyst space	6·3 c.c.
Air ratio	3 times theoretical.
Time of contact	0·32 sec.
Carburettor temp.	172°C.
Temp. of catalyst bed	290°C.

About 60% of the naphthalene used was attacked and the yield of phthaleic anhydride was 90% of theoretical.

The following intermediate products have been identified: naphthol, 1–4 naphthaquinone, phthalic anhydride, benzoic acid and maleic acid. The mechanism of the oxidation is explained with the help of hydroxylation theory, the *p*-dihydroxy compounds being supposed to be formed at a high temperature.

88. Studies in the naphthalene series, Part I. The synthesis of alkyl naphthols.

R. D. Desai, A. Kamal, M. Akram, *and* Abdul Hamid, Aligarh.

2-acetyl-β-naphthol and 2-propionyl-α-naphthol, give on Clemmensen reduction 2-ethyl-α-naphthol and 2-propyl-α-naphthol. Methods for the preparation of 4-acetyl-α-naphthol and 4-propionyl-α-naphthol in good yield have been worked out, and these yield on reduction 4-ethyl-α-naphthol and 4-propyl-α-naphthol. The bromination and nitration of these acylnaphthols as well as alkylnaphthols have been studied, and the constitutions of the resulting products have been elucidated.

89. Studies in the naphthalene series, Part II. The synthesis of 2 : 4-diacyl-α-naphthols.

R. D. Desai, M. Akram, *and* Abdul Hamid, Aligarh.

Various 2 : 4-diacyl-α-naphthols have been prepared by the action of acylchlorides on 2-acyl-α-naphthol in presence of anhydrous zinc chloride or on 4-acyl-α-naphthol in presence of anhydrous aluminium chloride. Bromination as well as nitration revealed the labile character of the acyl group in the 4-position. The same acyl group can also be replaced by hydrogen by the action of anhydrous aluminium chloride or zinc chloride. With the object of determining the constitution of the products obtained by brominating and nitrating 2 : 4-diacyl-α-naphthol, chromones have been prepared; and these have been degraded to various 1-hydroxy-2-naphthoic acid derivatives.

90. Studies in the naphthalene series, Part I. Synthesis of polyhydroxy derivatives of naphthalene.

S. N. Chakravarti *and* V. Pasupati, Agra.

An account is given of the attempts that have been made by the authors to synthesize symmetrically disubstituted and tetrasubstituted hydroxy derivatives of naphthalene, which were required for purposes of a comprehensive study of their properties and more particularly for the study of their oxidation products. Attempts were first made to synthesize 1 : 2 : 6- and 1 : 2 : 7-trihydroxy naphthalene and 1 : 2 : 5 : 6- and 1 : 2 : 7 : 8-tetrahydroxy naphthalene from the corresponding amino compounds which were synthesized for the purpose, but in none of these cases could the amino group be replaced by the hydroxy group although a variety of different conditions was tried. Next attempts were made to synthesize the required hydroxy compounds from the corresponding bromo compounds through the Grignard reaction, etc., but here again results obtained were not at all encouraging. Eventually 1 : 2 : 6- and 1 : 2 : 7-trihydroxy naphthalenes were synthesized by the following method which is being extended to the synthesis of the tetrahydroxy compounds. 2 : 7- and 2 : 6-dihydroxy naphthalenes were converted into nitroso compounds and the latter reduced to the corresponding amino compounds, which on oxidation under very careful conditions gave 6-hydroxy- and 7-hydroxy-naphthaquinones. The quinones on reduction gave the required trihydroxy naphthalenes which were also converted into the corresponding triacetyl and trimethoxy compounds. The hydroxy quinones have been nitrated and the mononitro compounds converted into the corresponding nitro-trihydroxy compounds by reduction with sulphur dioxide and the trihydroxy compounds in their turn were converted into nitro-trimethoxy compounds. The nitrohydroxy quinones have also been directly reduced to corresponding trihydroxy amino compounds.

91. Synthesis of coumarins from phenols and acetoacetic esters : constitution of halogenated resorcins and orcins.

D. CHAKRAVARTI *and* S. MUKERJEE, Calcutta.

Bromoresorcin (*Zehenter, Monatsh, 8,* 293), prepared from resorcylic acid, has been shown to be 4-bromoresorcin since 6-bromo-7-hydroxy-4-methylcoumarin (m.p. 278°C), the coumarin derived from bromoresorcin by condensation with acetoacetic ester, gives 6-bromo-7-methoxy-4-methyl coumarin (m.p. 245°C) identical with the product obtained by Sandmayer's reaction on 6-amino-7-hydroxy-4-methylcoumarin, the reduction product of the nitro derivative of β-methyl-umbelliferone methyl ether. The coumarin thus obtained from bromoresorcin is different from 8-bromo-7-hydroxy-4-methylcoumarin (m.p. 251-252°C), obtained by Sandmayer's reaction on 8-amino-7-hydroxy-4-methylcoumarin, the reduction product of the nitro derivative of β-methyl-umbelliferone.

Monochloro-orcin, prepared by the action of sulphuryl chloride on orcin and monobromo-orcin (Lamparter, *Annalen*, 1865, *134,* 258) have been shown to be 4-chloro- and 4-bromo-derivatives of orcin since they form 5-hydroxy-coumarins and not 7-hydroxy-coumarins by condensation with acetoacetic ester and its alkyl-derivatives.

These halogenated resorcins and orcins give always coumarins with acetoacetic ester and its derivatives even if the condensing agent is phosphorus pentoxide; thus the generalization made by Chakravarti (*J. Indian Chem. Soc.*, 1932, *9,* 31) holds true in these cases also.

92. The Pechmann condensation of methyl-β-resorcylate with α-alkyl-acetoacetic esters.

S. M. SETHNA *and* R. C. SHAH, Bombay.

In continuation of the work reported last year (*Indian Sc. Cong. Abst.*, 1937, 21), methyl-β-resorcylate has been condensed with α-methyl-, α-ethyl-, α-propyl- and α-butyl-, acetoacetic esters in the presence of sulphuric acid. In each case the condensation product was a mixture of 7-hydroxy-4-alkyl-coumarin-6-carboxylic acid and the corresponding methyl ester, from which the free acid and the ester were separated pure. The constitutions of all the condensation products have been established and various derivatives prepared.

93. Aluminium chloride—a new reagent for the condensation of β-ketonic esters with phenols, Part I. Condensation of methyl β-resorcylate with ethyl acetoacetate.

S. M. SETHNA *and* R. C. SHAH, Bombay.

The authors have previously studied the condensation of methyl β-resorcylate with ethyl acetoacetate in the presence of sulphuric acid, which gave methyl 7-hydroxy-4-methyl-coumarin-6-carboxylate (*Indian Sci. Cong. Abst.*, 1937, 21). It is now found that with anhydrous aluminium chloride as condensing agent, the condensation proceeds differently with the formation of methyl 5-hydroxy-4-methyl-6-carboxylate (I), m.p. 185-186°C, in good yield and a small quantity of the corresponding 7-hydroxy compound. (I) on hydrolysis gave the corresponding carboxylic acid, m.p. 248-249°C, which on decarboxylation gave 4-methyl-5-hydroxy-coumarin, m.p. 263°C, also in good yield, whose constitution was confirmed by conversion into the methylated cinnamic acid. Limaye has recently reported the formation of 4-methyl-5-hydroxy-coumarin in a minute yield in the Kostanecki acetylation of 2-acetyl resorcinol, itself obtained from resorcinol through a number of stages (*Rasayanam*, 1936, 45).

The unique action of aluminium chloride in the above condensation which directly affords a 5-hydroxy-coumarin derivative, instead of the 7-hydroxy compound, which is obtained with other known condensing agents is noteworthy. The work is being extended to other phenol-carboxylic acids and their esters.

94. Aluminium chloride—a new reagent for the condensation of β-ketonic esters with phenols. Part II. Condensation of resacetophenone with ethyl acetoacetate.

N. M. Shah *and* R. C. Shah, Bombay.

The condensation of resacetophenone with ethyl acetoacetate with aluminium chloride as condensing agent affords 5-hydroxy-4-methyl-6-acetyl-coumarin (I), m.p. 165°, in high yield, the condensation being analogous to that of methyl β-resorcylate, described in the previous paper. The constitution of (I) has been established and confirmed by its synthesis by the Fries transformation of 4-methyl-5-acetoxy-coumarin.

The formation of the corresponding 7-hydroxy-coumarin, 4-methyl-7-hydroxy-6-acetyl coumarin in the sulphuric acid condensation of resacetophenone with ethyl acetoacetate (Aggarwal and Dutt, *J. Indian Chem. Soc.*, 1937, *14*, 109) could not be confirmed, only unchanged resacetophenone being obtained (*cf.* Gaind, Gupta and Ray, *Current Sci.*, 1937, *5*, 646).

Further work including the condensation of other phenolic ketones and the synthesis of coumarino-chromones from (I) is in progress.

95. Aluminium chloride—a new condensing agent for the condensation of β-ketonic esters with phenols, Part III. Condensation of ethyl acetoacetate with simple phenols.

N. M. Shah, S. M. Sethna, *and* R. C. Shah, Bombay.

The condensation of ethyl acetoacetate with various phenols in the presence of anhydrous aluminium chloride has been studied. The solvent used was dry ether in which aluminium chloride dissolves readily (cf. Shah, *Current Sci.*, 1934, 157) or nitrobenzene. In most cases, the same products are formed as with sulphuric acid as condensing agent. In some cases the yields are better than with sulphuric acid; the most remarkable example being phenol, which gives a 30–40% yield of the coumarin with aluminium chloride, whereas the yield reported in literature for phenol with sulphuric acid is only 3%.

96. Heterocyclic compounds, Part VI. Coumarins from resacetophenone and cyclic-β-ketonic esters.

R. D. Desai *and* Nazir Ahmad, Aligarh.

Resacetophenone condenses with cyclohexanone-2-carboxylate, 4-methylcyclohexanone-2-carboxylate, 5-methylcyclohexanone-2-carboxylate, 6-methyl cyclohexanone-2-carboxylate and trans-β-decalone-3-carboxylate in the presence of phosphorus oxychloride with the formation of 7-hydroxy-5-acetyl-3 : 4-cyclohexeno- or 3 : 4-cyclo-octaline-coumarins. This condensation does not take place in the presence of concentrated sulphuric acid or sodium ethoxide. The isomeric 7-hydroxy-8-acetyl coumarins have been obtained by the Fries transformation of the respective 7-acetoxy coumarins obtained by the acetylation of the coumarins from resorcinol and respective β-ketonic esters in the presence of concentrated sulphuric acid.

97. Heterocyclic compounds, Part VII. Coumarins from phenols and cyclic β-ketonic esters.

R. D. Desai *and* Nazir Ahmad, Aligarh.

Coumarins have been obtained by condensing 4-methylcyclo-hexanone 2-carboxylate, 5-methylcyclohexanone-2-carboxylate, 6-methylcyclohexanone-2-carboxylate and trans-β-decalone-3-carboxylate with resorcinol, orcinol, phloroglucinol, pyrogallol and -naphthol in the presence of concentrated sulphuric acid. The various derivatives and other properties of these coumarins have been studied.

98. Heterocyclic compounds, Part VIII. Chromones from 4-ethyl-resacetophenone.

R. D. Desai *and* Sh. Abdul Hamid, Aligarh.

Excepting the work of Wittig and his co-workers (*Annalen*, 1925, 460) on the application of the Kostanecki reaction to *o*-acyl derivatives of the cresols, no systematic work has been done. Flavones containing alkylated benzene nucleus have been found to occur in nature. Therefore, a systematic study of the synthesis of this type of chromones and flavones has been undertaken. On heating 4-ethyl resacetophenone with acetic anhydride and anhydrous sodium acetate, 7-acetoxy-6-ethyl-3-acetyl-2-methylchromone was obtained. This was converted into 7-hydroxy-6-ethyl-3-acetyl-2-methylchromone and 7-hydroxy-6-ethyl-2-methylchromone. The various derivatives of 7-hydroxy-6-ethyl-2-methylchromone have also been prepared.

99. Coumarin-4, brom- and 3, bromacetic acids.

B. B. Dey *and* S. Sankaran, Madras.

A study of the reactivities of the bromine atoms in the two series has been carried out with interesting results. Although the halogen in coumarin-4, methobromides was found to be very inactive (Dey and Radhabai, *J. Indian Chem. Soc.*, 1934, *11*, 636), the corresponding hydroxymethyl- and acetoxy-methyl compounds have now been prepared.

100. The reactivity of the chalkone oxides.

K. D. Mudbhatkal *and* T. S. Wheeler, Bombay.

The reactions of the oxide of *p*-tolyl-4-methoxy styryl ketone have been studied. It gave a *diketone* and a *glycollic acid* with sodium hydroxide. With hydrazine hydrate it yielded the *hydroxy pyrazoline* which with sodium ethoxide gave the *pyrazole*. The glycollic acid is converted into a desoxybenzoin by potassium chromate. The *acetoxy* and *chlorohydrin* derivatives have also been prepared.

A number of condensations of chalkones with desoxy-benzoins have also been studied.

101. The reactivity of the chalkones of bromopiperonal.

G. V. Deshmukh *and* T. S. Wheeler, Bombay.

The chalkone obtained by the condensation of bromopiperonal with acetophenone gave a dibromide which with pyridine gave a *bromostyryl-ketone*. The dibromide on treatment with 2 mols of sodium ethoxide gave an *ethoxy-styryl ketone* which with HCl gave a *diketone*. The dibromide on treatment with alcoholic ammonia gave an *ammonia compound*.

Bromopiperonal and acetonaphthol were condensed to a *hydroxy chalkone.* This with sodium acetate and acetic anhydride gave an *acetoxy chalkone* which on bromination gave a *dibromide.* The hydroxy chalkone also gave a dibromide which on heating under reduced pressure gave a *flavone.* The hydroxy chalkone with alcoholic phosphorus pentoxide also gave a flavanone.

102. Synthesis of benzylidenebenzocoumaranones.

A. P. KHANOLKAR *and* T. S. WHEELER, Bombay.

Ingham, Stephen and Timple (*J.*, 1931, 895) attempted to synthesize benzocoumaranones from naphthoxyacetic acids but were unable to decide definitely the structure of the products. The new unambiguous synthesis of benzylidenecoumaranone by the action of alkali on *o*-hydroxyphenyl-α-bromo-β-ethoxy-phenylethyl ketone (*Current Sci.*, 1937, 475) has been applied to 1-hydroxy-2-naphthyl-α-bromo-β-ethoxy-3′-4′-methylenedioxystyryl ketone and a benzylidenebenzocoumaranone obtained. The dibromides of 1-hydroxy-2-naphthylstyryl ketones are but slightly soluble in alcohol and do not readily form ethoxy derivatives ; accordingly they yield naphthoflavones by Kostanecki's dibromide method. They are soluble in chloroform and on heating with a mixture of absolute alcohol and chloroform pass to the ethoxy compounds.

103. New syntheses of flavones.

W. A. HUTCHINS *and* T. S. WHEELER, Bombay.

The dibromides of *o*-hydroxyphenyl styryl ketones which ordinarily give benzylidene-coumaranones on treatment with alkali by Kostanecki's method yield flavones if directly heated.

A new synthesis of chrysin is obtained by brominating 2-hydroxy-4 : 6-dimethoxy-phenyl styryl ketone. The product is heated to give a bromoflavone which on treatment with hydriodic acid yields chrysin.

Similarly 2-hydroxy-4 : 6-dimethoxy-phenyl-4-methoxy-styryl ketone is brominated and the product heated to give a bromo-flavone which on treatment with hydriodic acid yields apigenin.

The bromide of 2-hydroxy-4 : 6-dimethoxy-phenyl-3 : 4-dimethoxystyrylketone is unstable, presumably because of the number of methoxy groups present. It is hoped that the use of the dinitrobenzyl ether of protocatachuic aldehyde will enable the synthesis of leuteolin to be achieved by this method.

104. 2-naphthyl chromones.

V. V. VIRKAR *and* T. S. WHEELER, Bombay.

The methyl ester of 2-methoxy-3-naphthoic acid has been condensed with 2-methoxy-acetonaphthone to give 2 : 2′-dimethoxy-3 : 1-dinaphthoyl-methane. This on treatment with cold concentrated hydriodic acid (*d.* 1·7) gives a 2-naphthyl-benzochromone.

Similarly, the methyl ester of 2-methoxy-3-naphthoic acid has been condensed with *o*-methoxyacetophenone to give 2 : 2′-dimethoxy-benzoyl-3-naphthoyl methane. The action of HI on the latter is being studied.

105. On the constitution of plant alkaloids. (A discourse.)

R. ROBINSON, Oxford.

106. Rottlerin.

K. S. NARANG *and* J. N. RAY, Lahore.

Evidence has been adduced that rottlerin has the composition $C_{27}H_{26}O_7$. Four of the oxygen atoms occur as phenolic hydroxyl groups.

The tetramethyl ether (m.p. 144°) is not further acylated indicating that the remaining oxygen atoms are ethereal or inert. The formation of a tetrahydro derivative indicates the presence of two double bonds. Oxidation of the tetramethyl ether with hydrogen peroxide gives a substance $C_{31}H_{36}O_8$ which decomposes into benzaldehyde and other unrecognizable substances.

Hydrolysis of tetrahydrorottlerin with alcoholic hydrochloric acid gives a substance $C_{20}H_{22}O_4$, m.p. 171°C, the structure of which is discussed.

Tetramethyl rottlerin reacts with nitrous acid to give a substance $C_{17}H_{19}NO_5$ (or $C_{19}H_{21}NO_6$?) which is being further degraded.

The structures of the different products described above have been discussed and a tentative formula for rottlerin has been advanced.

107. Synthetical experiments with dimethyldiazomethane, Part I. New synthesis of caronic and homocaronic acid.

P. C. GUHA *and* D. K. SANKARAN, Bangalore.

Although diazomethane and diazoacetic ester have found application in the synthesis of some monocyclic and bicyclic derivatives of compounds of the thujane group, no synthetic investigations are on record in which dimethyl-diazomethane has been used for such synthesis. Dimethyl-diazomethane has been found to react with ethyl-fumarate at -18° to give a pyrazoline compound yielding finally trans-ethyl caronate. Dimethyl diazomethane reacts similarly with diethyl glutaconate to yield homocaronic acid, which has recently been synthesized by Owen and Simonsen by a different method.

108. A new and direct synthesis of dihydro-isolauronolic- and iso-lauronolic acids.

P. C. GUHA *and* K. S. SUBRAMANIAN, Bangalore.

The formation of iso-lauronolic acid from derivatives of camphor such as α-campholytic acid, camphoric anhydride, etc., involves a peculiar molecular rearrangement and therefore a direct synthesis of this acid is interesting. Ethyl dimethyl-acetoacetate reacts with ethyl-α-bromo-succinate in presence of zinc (Reformatsky) to give a mixture of ethyl α : α : β-trimethyl-β-hydroxy-β′-carbethoxy adipate (I) (acid, m.p. 165-166°C) and ethyl α : α : β-trimethyl-γ-carbethoxy-β-butylene-α : δ di-carboxylate (II). The mixture gives the latter ester (II) (b.p. 155–162°/5 mm.; acid, m.p. 239-240°C; trianilide, m.p. 235°C; anilide anil, m.p. 212°C) with PBr_3 in dry chloroform and undergoes cyclization with sodium in dry benzene to form among other products ethyl 1 : 1 : 2-dimethyl-Δ^2-cyclopentene-5-one-3 : 4-dicarboxylate, b.p. 125–128°/3 mm. This ester is soluble in alkali, gives violet coloration with alcoholic $FeCl_3$, and does not react with semicarbazide or hydroxylamine; on hydrolysis with dil. alc. KOH it forms an unstable syrupy ketonic acid, which loses carbon dioxide on treatment with hydrochloric acid forming 1 : 1 : 2-trimethyl-Δ^2-cyclopentene-5-one-3-carboxylic acid designated keto-isolauronolic acid, m.p 186-187°C, (oxime, m.p. 139-140°; semicarbazone, m.p. 225°). This on Clemmensen's reduction was expected to give isolauronolic acid, but during the reaction, the ethylenic linkage was also reduced, forming mainly dihydro-isolauronolic acid (b.p. 110–115°/20 mm.) from which iso-lauronolic acid has been obtained by methods already known.

(I) $(COOEt).CH_2.CH\ (CO_2Et).C(OH)\ CH_3.CMe_2.CO_2Et$

(II) $(COOEt).CH_2.C(CO_2Et) : CMe.\ CMe_2.CO_2Et.$

109. Investigations on the nature of products obtained by the addition of diazo-compounds to conjugated double bonded systems, Part I. A new synthesis of iso-dehydroapocamphoric acid and a synthesis of Δ^4-cyclo-pentene-1 : 3-dicarboxylic acid.

P. C. Guha *and* D. K. Sankaran, Bangalore.

The addition of aliphatic diazo-compounds to conjugated double bonded systems has mostly been effected with hydrocarbons which, as a rule, accept diazomethane, etc., by a process of addition in 1 : 2 positions.

Dimethyl diazomethane reacts with ethyl muconate at −18°C and yields ethyl isodehydroapocamphorate (b.p. 200°/100 mm.). Diazomethane reacts similarly with ethyl muconate to yield ethyl Δ^4-cyclopentene- 1 : 3-dicarboxylate (I) which has resisted all attempts to reduce it into the saturated cyclopentane-1 : 3-dicarboxylic acid. The 1 : 4-addition, in this case, has been proved by the isolation of glutaric acid by successive stages of oxidation of compound (I).

110. Investigations on the nature of addition of aliphatic diazo-compounds to conjugated systems, Part II. Action of diazomethane and diazoacetic ester upon cyclopenta- and cyclohexadienes and their derivatives.

P. C. Guha *and* G. D. Hazra, Bangalore.

The present investigation has been undertaken with the object of synthesizing bicyclic compounds of the camphane and santane series by effecting 1 : 4-bridge formation in cyclic compounds, possessing conjugated double bonds, by the action of aliphatic diazo compounds. $\Delta^{1:3}$-dihydrobenzene and 2 : 3-dimethyl-$\Delta^{1:3}$-dihydrobenzene (cantharene) have not been found to react with diazomethane even after one month's standing at 0°. $\Delta^{1:3}$-dihydrobenzene reacts with diazoacetic ester to give a compound (b.p. 84°/2·5 mm.). That the addition has taken place in 1 : 2-positions (and not in 1 : 4), in spite of the starting compound possessing conjugated double bonds has been proved by reducing the product catalytically to ethyl norcarane carboxylate, b.p. 112–14°/19·20 mm. (the m.p. of the related acid is 97°C). The b.p. and m.p. of the corresponding ester and the acid as given by Ebel, Brunner and Mangelli (*Helv. Chem. Acta.*, 1929, *12*, 19–26) being 110-11°/18 mm. and 97° respectively, prove the identity of our product with theirs.

Cantharene reacts with diazoacetic ester to give an ester, b.p. 91–95°/ 2·5 mm., which gave two acids now under investigation.

To study the influence of negative groups like CO_2Et and CO adjacent to 1 : 4-carbon atoms in conjugated double bonded systems, on the addition of diazomethane and diazo-acetic ester, etc., $\Delta^{1:3}$-dihydroterephthalic ester, *o*-benzoquinone and methylbenzoquinone are being condensed with these.

111. Synthesis of umbellulonic acid.

P. C. Guha *and* M. S. Muthanna, Bangalore.

Ethyl isopropyl acrylate (Blaise and Luttinger, *Bull. Soc. Chem.*, 1905 (3), *33*, 648, 776) has been condensed with diazoacetone (*Annalen*, 1925, *1*, 34; 1916, *1*, 855) to yield a pyrazoline compound, b.p. 130–135°C 3 mm. (Found: N, 11·68%; calc. 12·39%). The pyrazoline compound splits off nitrogen at 180°C, and the resulting nitrogen free ester distils at 135–145°/25 mm. and was expected to yield umbellylonic acid on hydrolysis. The resulting acid, however, does not readily crystallize but forms an oxime, m.p. 145-146°C (Found: N, 7·64%; calc. 7-53%), and a semicarbazone, m.p. 170° (Found: N, 18·30%; calc. 18·42%), the corresponding m.p.'s of the oxime of cisumbellulonic acid (derived from natural umbellulone) being 169-170°C; semicarbazone not known.

The cis-configuration of umbellulonic acid now synthesised has been proved by its conversion into cis-umbellularic acid monohydrate. The latter does not depress the m.p. of an authentic specimen derived from natural sources.

112. Attempted synthesis of cantharidin, Part I.

P. C. GUHA *and* B. H. IYER, Bangalore.

The best condition under which the sodium derivative of oxalodiglycollic ester reacts with ethylene bromide (cf. *Sci. Cong. Proc.*, 1935, 146) is to heat the dry disodium derivative with an excess of the alkylene halide at 160–170° under reflux during 72 hours. When repeatedly crystallized from alcohol, the alkali insoluble portion of the product (structure advanced) melts at 174-75°C. The di-ester on hydrolysis with alkali readily gives the corresponding di-acid, m.p. 316°C (decomp.). The stability of the di-acid towards boiling hydrochloric acid (1 : 1) rules out the possible β-ketonic ester type of formula of the condensed product. Hence, the compound is represented by a formula in which three oxygen atoms take part in the formation of a bicyclo heterocyclic ring.

If the product had a β-ketonic structure, it would have been a very convenient starting material for the synthesis of cantharidin.

The sodium derivative of oxalodiglycollic ester has been similarly condensed with trimethylene bromide and the product melts at 139°. Oxalothiodiglycollic ester similarly reacts with ethylene bromide to yield an analogous alkali-insoluble product melting at 148–50°C.

113. Attempted synthesis of cantharidin, Part II.

P. C. GUHA *and* B. H. IYER, Bangalore.

The synthesis of cantharidin has been attempted starting from suitable furan derivatives, with a view to avoiding, in later stages, the necessity of constructing the oxygen bridge present in the cantharidin molecule.

The condensations of the di-acid chlorides of furan-2 : 5-dicarboxylic acid and tetra-hydrofuran dicarboxylic acid with zinc methyl iodide have been effected and the corresponding 2 : 5-diacetyl compounds have been isolated. It is intended to utilize these for the synthesis of cantharidin.

114. Researches on the formation of polycyclic compounds from succino-succinic ester.

P. C. GUHA, Bangalore.

Ethyl succinosuccinate has been condensed with brom-acetic ester and the resulting product yielded after hydrolysis and decarboxylation *cyclo*hexane-1 : 4-dione diacetic acid. The ester of this acid is being condensed with brom-acetic ester and phenyl brom-acetic ester (Reformatsky) with the object of converting the resultant tetra-esters into interesting tricyclic compounds.

The *bicyclo*-(2:2:2)-octane-derivative, m.p. 112°C (*cf.* last year's report), has been utilized for the preparation of interesting derivatives. It is intended to transform these into compounds of tricyclene type and other condensed systems.

115. The physical identity of enantiomers, Part V. The relation between concentration and viscosity of solutions of *d*-, *l*- and *dl*- forms of camphor, isonitrosocamphors, camphorquinone, camphoric acid and sodium camphorate.

B. K. Singh, Patna.

This paper deals with the problem of finding out a relation connecting concentration with the viscosity of solutions of *d*-, *l*- and *dl*- forms of camphor, isonitrosocamphors, camphorquinone, camphoric acid and sodium camphorate. The viscosity data of these compounds (*Proc. Ind. Acad. Sci.*, *5*, 484, 1937) have been analysed. The simple mixture law cannot express the viscosity of these solutions. Kandall's formula containing the cube root of the viscosity is also found to be unsatisfactory. The logarithmic viscosity formula of Arrhenius generally fits in well with observations, when the concentration is expressed as mols per 1,000 grams of solvent, the only exception being the isonitrosocamphors. The applicability of the Arrhenius equation is also illustrated by plotting logarithms of viscosity against molecular concentration when straight lines are obtained.

116. Synthesis of Thujane.

P. C. Guha *and* S. Krishnamurthy, Bangalore.

Ethyl 1-methyl-3-isopropyl-cyclopentane-2-one-1-carboxylate prepared from diethyl adipate (*Annalen*, 1906, *350*, 226) was reduced to the corresponding secondary alcohol which was then converted into ethyl 1-methyl-3-isopropyl-Δ^2-cyclo-pentene-1-carboxylate by the action of phosphorus pentoxide in boiling benzene solution. This unsaturated ester reacted with diazomethane, on keeping for two weeks at 0°C to yield a bicyclic compound which can be regarded as thujane with a COOEt group in position 1. The corresponding acid obtained from the ester by hydrolysis (m.p. 93-94°) gave, on distillation with soda lime under reduced pressure, thujane b.p. 155-56°C; n_D, 1·4400; d^{26}_{26} 0·8143; the corresponding values of thujane as given by Semmler and Feildstein being b.p. 156-57°C; d^{22}_{21}, 0·8158; n_D, 1·44121.

117. Attempts at synthesis of thujadicarboxylic acid.

P. C. Guha *and* M. S. Muthanna, Bangalore.

Ethyl β-isopropyl acrylate (*J.*, *77*, 942) has been condensed with sodio-malonic ester and the resulting product ethyl β-isopropyl-γ'-carbethoxy-α'-glutarate (I), b.p. 145–148°/4 mm., isolated. The α-bromo-compound (II), b.p. 175–176°/4 mm. (Found: Br, 20·82; calc. 21·0%), obtained from (I) by bromination, lost HBr on treatment with diethylaniline to yield an unsaturated compound (III) (structure advanced). The unsaturated ester on treatment with diazomethane yielded a product distilling at 135–140°/3 mm. and is expected to give thujadicarboxylic acid on hydrolysis and decarboxylation.

Work is also in progress on the synthesis of thujaketonic acid, starting from β-isopropyl-α-acetoglutaric ester.

118. On synthesis of bicyclo- (1 : 2 : 2)-heptane and bicyclo-(2 : 2 : 2)-octane systems.

P. C. Guha *and* C. Krishnamurthy, Bangalore.

In continuation of the work reported last year (*Science Congress, Chemical Abst.*, 1937, 137), the synthesis of the bicyclo-(2 : 2 : 2)-octane compound, m.p. 112° has been attempted by double Dieckmann's condensation with hexane-1 : 2 : 5 : 6-tetra-carboxylic ester.

Ethyl hexane-(1 : 2 : 2 : 5 : 5 : 6)-hexacarboxylate obtained from ethyl butanetetracarboxylate and ethyl bromacetate, gives on hydrolysis and decarboxylation, hexane- 1 : 2 : 5 : 6-tetracarboxylic acid. The corresponding tetra-ester on treatment with sodium in toluene has given two products, one soluble (also giving coloration with ferric chloride) and the other insoluble in alkali. Methyl pentane-1 : 2 : 4 : 5-tetracarboxylate, prepared from methylene dimalonic and brom-acetic esters, has also been cyclized with sodium in toluene solution giving rise to two products—alkali-soluble and alkali-insoluble; the alkali-soluble products in either case on hydrolysis with boiling hydrochloric acid have given interesting compounds which are under investigation.

119. Synthesis of cyclohexane-spiro-cyclohexane derivative.

N. N. Chatterjee, Calcutta.

The effect of cyclohexane ring attached to a quaternary carbon atom in a chain on the formation of a new cyclohexane ring has been studied with the expectation of gaining some insight into the nature of strain in the existing cyclohexane ring.

The condensation product of cyclohexanone cyanohydrin and ethyl sodio-cyanoacetate when treated with ethyl γ-bromobutyrate gives diethyl 1-cyano cyclohexane-1-α-cyanoadipate (b.p. 220–30°/3 mm.). This cyano ester on hydrolysis gives cyclohexane-1-carboxylic-1-α-adipic acid (gummy solid). The corresponding ester (168–75°-4 mm.) is subjected to the action of sodium when cyclohexane-spiro-cyclohexane-2-one-3 : 6-dicarboxylate (b.p. 170°/3 mm.) is obtained. The ring formation takes place with almost equal facility as in the case of the corresponding cyclopentane ring (cf. *J. Indian Chem. Soc.*, *13*, 536, 1936).

120. Synthesis of polycyclic compounds having an angular methyl group.

N. N. Chatterjee, Calcutta.

The presence of an angular methyl group is encountered in the terpenes, alkaloids and sterol group but few synthetic methods exist for its introduction in a molecule.

Now with a view to synthesize polycyclic compounds having angular methyl group the investigation described below was undertaken.

Naphthyl magnesium bromide has been reacted with ethyl-2-methyl methyl cyclohexanone-2-carboxylate to yield ethyl-1-α-naphthyl-2-methyl cyclohexanol-2-carboxylate (b.p. 220°–25°/6 mm.). This on dehydration yields ethyl-1-α-naphthyl-2-methyl cyclohexane-2-carboxylate (b.p. 210–220°/6 mm.). This unsaturated ester is reduced catalytically to yield ethyl-1-α-naphthyl-2-methyl cyclohexane-2-carboxylate (b.p. 208–10°/6 m.m.) 1-α-naphthyl-2-methyl cyclohexane-2-carboxylic acid (b.p. 235–245°/7 mm.) obtained after hydrolysis of the ester is converted into acid chloride and subjected to the action of aluminium chloride to yield methyl hexahydro-peri-benzanthrone (b.p. 215–25°/4 m.m.) This derivative has been reduced to methyl hexahydro isochryso-fluoren, the constitution of which has been established by its conversion to isochryso-fluoren.

121. Superheated steam in the distillation of Atalantia monophylla oil.

M. T. CHOBE *and* B. SANJIVA RAO, Bangalore.

The essential oils from Atalantia monophylla and spheranthus indicus have been distilled in steam at different temperatures and pressures and the data presented. The higher the temperature of the steam, the more is the quantity of oil distilling over per unit of steam. The properties of such oils distilled over have been examined. Atalantia monophylla oil was obtained *in a yield of 0·4 to 0·5 per cent.* from the leaves and was unaffected by distillation at 140°C. It has a pleasant citrus odour very similar to that of the oil from Zanthoxalum Bundrunga, Wall (*Jour. Ind. Inst. Sci.*, 1925, *8*, 174).

122. Essential oil from the leaves of *Sphrenthus indicus.*

(MISS) MARY MATHEN *and* B. SANJIVA RAO, Bangalore.

The oil was obtained in a yield of 0·4 per cent. and has been found to consist of phellandrene and a mixture of mono and bicyclic tertiary alcohols. A crystalline acid and a crystalline alcohol $C_{15}H_{24}O$ (m.p. 64°) have been isolated from the oil.

123. Essential oil from *Litsœ zeylainca* : the occurrence of *dl*-cadinene.

(MISS) MARY MATHEN *and* B. SANJIVA RAO, Bangalore.

A hydrocarbon $C_{15}H_{24}$ occurring in the essential oil from Litsæ zeylanica had been found to yield a solid dihydrochloride on treatment with hydrochloric acid but as sufficient quantity was not available it had not been closely investigated (*Jour. Indian Inst. Sci.*, 1932, *15*, 47). A fresh supply of two samples having become available, it was found that the dihydrochloride from one of them melted at 106°C after crystallization from ethyl acetate or acetone and was optically inactive. It appeared to be a hydrochloride of a hitherto unknown hydrocarbon which has been called litsenene. The hydrocarbon gave an excellent yield of cadalin on treatment with sulphur. The hydrochloride from the second sample of the oil was found to be a mixture from which the optically inactive dihydrochloride (m.p. 106°C) as well as the dihydrochloride of *d*-cadinene (m.p. 118°C; α_D,-37·4) could be separated. It appears probable that litsenene is identical with *dl*-cadinene.

124. Synthesis in the cardiac aglucone series.

S. K. RANGANATHAN, Bangalore.

The cardiac aglucones would seem to owe their physiological action to the lactone group in the molecule, and the aetiocholane ring structure serves the purpose of a convenient framework for the placing of the lactone group. To substantiate this view-point, work has been started with the object of synthesizing lactones of related structure but carrying different rings. The method here adopted is based on the mechanism of formation of the lactones from norcholanic acid as postulated by Windaus (*Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen*, new series, Vol. 1, No. 7).

Cyclo-pentyl bromide reacts with ethyl sodio-α-carbethoxy succinate to yield ethyl α-cyclopentyl-α-carbethoxy succinate, b.p. 172°C/6 mm. The corresponding tricarboxylic acid furnishes on thermal decomposition α-cyclopentyl succinic acid, m.p. 116-117°C (anhydride, b.p. 176°C/30 mm. ethyl α-cyclopentyl succinate, b.p. 147°C/9 mm.) and yields on reaction with sodium and ethyl formate what is apparently a mixture of the two α-aldehydic cyclopentyl succinic acids. Ethyl α-cyclopentyl-β-aldehydo succinate has been isolated via its copper salt. (*p*-nitrobenzoyl ester, m.p. 238°).

Experiments undertaken in connection with the synthesis of α-cyclopentyl-succinic acid by a different method are also described, as also the condensation of cyclopentyl bromide with ethyl sodioacetone-dicarboxylate with a view to the ultimate synthesis of Wieland and Dane's acid $C_{13}H_{20}O_6$ (*Z. Physiol. Chem.*, 1933, *216*, 91).

125. Preparation of pure thevetin from the seeds of *Thevetis neriifolia.*

J. K. Lahiri *and* R. N. Chopra, Calcutta.

The glucoside thevetin is likely to prove to be a potent drug useful in cardiac trouble as shown by recent clinical trials. For the isolation and purification of the glucoside, the published methods either lack in detail or lead to very poor yields. Details of a modified method for the isolation and purification of thevetin are given. Some of its properties and reactions together with a complete bibliography are also added. The pharmacological action of the compound was found to be similar to that described by Chen and Chen. Further work on its pharmacology is in progress.

126. Investigation on the constitution of 'Artostenone', a keto compound related to sterols, present in the Indian summer fruit 'Artocarpus Integrifolla', Part V. Oxidation of artostenone.

M. C. Nath, Dacca.

In continuation of my work of 'Investigations on the constitution of "Artostenone"' (*Proc. Ind. Sci. Congr.*, 1937; Hoppe-Scyler's *Z. Physiol. Chem.*, *247*, 9, 1937) experiments have been extended to study the action of different oxidizing agents on artostenone.

1. Oxidation of artostenone has been carried out by means of both neutral and acid permanganate.
2. A di-keto acid (di-keto artostanic acid) of the formula $C_{30}H_{50}O_4$, m.p. 136°C, has been obtained in both the processes.
3. The molecular weight of this di-keto acid as determined by cryoscopic method with benzene as solvent is 452; the formula requires 474 as the molecular weight.
4. This acid gives a dioxime, m.p. 173°C, and an anilide, m.p. 140-141°C.
5. Nitric acid oxidation results in the formation of a nitro acid with two condensed rings, which dissolves in potassium hydroxide solution with orange-red colour.
6 The nitro acid melts at 157–159°C with decomposition and its molecular weight has been found to be 229.
7. Oxidation with chromium trioxide gives a substance (a keto acid ?) melting at 88–90°C.

127. Investigation of the constitution of 'Artostenone', Part VI. Tautomerism of the double bond in artostenone and its relative position with respect to the keto-group.

M. C. Nath, Dacca.

1. Artostenone on refluxing with alcoholic solution of sulphuric acid (5%) is converted into the isomeric compound α-artostenone.
2. α-artostenone melts at 99-100°, and its oxime has m.p. 193-194°.

3. Artostenone does not condense with benzaldehyde, whereas α-artostenone forms benzylidene derivative.

4. It has been found that di-hydro artostenone also forms condensation product with benzaldehyde.

5. The number of bromine atoms, which enter a molecule of dihydro artostenone, by substitution, is three, while it is two in the case of the unsaturated compound, artostenone.

6. It is suggested that the CO group is at C_{12} whilst the double bond is between C_9 and C_{11}.

128. Chemical and pharmacological examination of the roots of *Hemideamus indicus*, Part I.

A. T. Dutt, S. Ghosh, *and* R. N. Chopra, Calcutta.

The roots are used in the Indian indigenous system of medicine and are said to act as diuretic, diaphoretic and tonic. The plant is known as the Indian Sarsaparilla. The roots, collected locally, were found to contain an essential oil, corresponding to about 0·225 per cent. of the air dried material, of which about 80 per cent. consisted of a solid crystalline compound melting at 42·4°C. This was identified as 2-oxy-4-methoxybenzaldehyde. The aroma of the drug, originally ascribed to coumarin, is due to this aldehyde. Two sterols, designated as Hemidosterol and Hemidesmol have also been isolated and analyzed. They melt at 176° and 161°C and show specific rotations of +69·87°C and +57·0°C respectively. Besides the presence of resins, tannins, etc., the roots show the presence of a glucoside, further work on which is in progress.

129. Chemical examination of mango ' chep ' (*Mangifera indica*).

S. K. Vasistha *and* Salimuzzaman Siddiqui, Delhi.

The fresh mango ' chep ' in liquid condition as well as the semi-solid mango chep resin have been investigated. The odorescent principle, present in the fresh chep, could not be isolated by steam distillation, which appears to destroy it. From the dry mango chep a resin (mangiferen) $C_{21}H_{34}O$, a resinous acid (mangiferic acid) $C_{40}H_{60}O_4$, and a resinol (mangiferol) $C_{42}H_{72}O_4$, were isolated and studied. Contrary to expectations, these resinous principles were found to be not allied to bhilawanol or anacardic acid. The degradation and oxidation products of mangiferen, which was more fully investigated, largely brought out their close relationship to the abietic acid series of resins, and supported the more recent view of resins being condensation products of isoprene.

130. The biogenesis of the terpenes and camphors.

K. Ganapathi, Bangalore.

Taking the clue from the relative abundance and the occurrence side by side of the various constituents of the oils, a theory of the biogenesis of the terpenes and camphors has been advanced starting from linalool. The chemical and biochemical aspects have been discussed and the suggested schemes have been shown to accommodate satisfactorily most of the known facts.

131. Sesquiterpene ketones, their structure and synthesis.

J. L. Simonsen, Bangor.

132. Chemical examination of the root of *Tabernamontana coronaria.*

P. Parameswaren Pillay, Trivandrum.

By percolation with cold alcohol, followed by removal of the solvent under reduced pressure, 7·7% of extractive matter were obtained. From these, 1·65% of total alkaloids were isolated, which could be separated into white and yellow amorphous bases which are very easily oxidized by atmospheric oxygen. There was also present in the extract a crystalline sterol, a sterol glucoside, palmitic, oleic and linoleic acid and an amorphous neutral substance.

133. Jute-seeds—*Corchorus capsularis*, Part IV. A resinous bitter from jute-seeds.

N. K. Sen, Dacca.

A resinous bitter has been isolated from the mother-liquor of Corchorin, the crystalline active principle of jute-seeds (*Corchorus capsularis*). It resembles the compound isolated from the seeds by E. Merck for Kobert for his experiments on animals. When hydrolyzed it yields reducing sugar and an insoluble aglycone. The paper deals with the structure of this compound provisionally named Corcho-resin.

134. Synthesis of new local anæsthetics.

K. N. Gaind *and* J. N. Ray, Lahore.

Various β-acyloxy β-phenyl ethyl amines have been synthesized with a view to find an ideal local anæsthetic. Solutions of hydrochlorides of β-*p*-aminobenzoyloxy β-phenyl ethyl methylamine (and related substances) are stable to boiling and are sterilizable. These substances diffuse slowly and hence can be used without adrenaline to produce anæsthesia lasting for a fairly long time.

135. A new colorimetric test for novocaine and primary amines.

S. N. Chakravarti *and* M. B. Roy, Agra.

When primary amines are treated with a solution of paradimethylaminobenzaldehyde in presence of hydrochloric acid, a yellow, greenish yellow or orange colouration is immediately obtained. This reaction can be utilized as an excellent test for primary amines and novocaine. This test should prove to be particularly valuable where a large number of samples have to be tested for the presence of novocaine, an usual adulterant for cocaine, as this test is not given by the majority of the other usual adulterants of cocaine and by cocaine itself.

136. Synthesis of arsenic analogue of succinimide.

H. N. Das Gupta, Calcutta.

It has been found possible to condense succinyl chloride with phenyl dichloro arsine to produce *l*-phenyl cyclo succinarsine. The structure assigned to the ring compound was proved to be correct by reducing the same by sodium and alcohol to a known arsine like phenyl cyclo tetramethylene arsine (Grutner and Krause, *Ber.*, 1916, *49*, 437). The m.p. and mixed m.p. of the methiodide derivative was found to be identical with that from 1 : 5-dibromobutane.

137. Benzo-isoquinolines.

B. B. Dey *and* S. Rajagopalan, Madras.

Isoquinolines with a naphthalene nucleus are not numerous and attempts have now been made to synthesize these bodies by different routes and lay down general rules regarding their formation. It is interesting to note that all attempts to cyclise the acylated α-naphthyl methyl amines on the peri-position were unsuccessful. This experience recalls the difficulty of preparation of isoquinolines from amines of the benzylamine type previously recorded by one of the authors.

138. Syntheses of *l*-chloromethyl- and *l*-α-chloroethyl-isoquinolines and their derivatives.

B. B. Dey *and* T. R. Govindachari, Madras.

These have been prepared from homo-piperonyl amine and chloracetic anhydride and lactide respectively. The corresponding cyano-methyl isoquinolines are found to condense with aldehydes to give interesting styrene derivatives. *l*-cyanomethyl-6, 7, methylenedioxy-3, 4, dihydroisoquinoline undergoes a rather curious oxidation with hydrogen peroxide to the corresponding *l*-keto-tetrahydroisoquinoline.

139. Synthetical experiments in the paraberine group, Part II. A synthesis of 3 : 12-dimethoxy-6 : 15 : 16 : 17-tetrahydro-17-keto-paraberine.

S. N. Chakravarti *and* P. L. N. Rao, Agra.

To throw light on the preferential selection of angular structures by nature, attempts were made to synthesize compounds of the type of paraberine having linear structures. Attempts to synthesize tetrahydroparaberine from (i) dibenzyl-methylamine by the action of formaldehyde or through formyl derivative and from (ii) *dl*-N-benzyl-phenylalanine were unsuccessful. These results support the conclusions of Perkin and coworkers on the subject. Attempts were next made to synthesize suitable dimethoxy-tetrahydro-paraberines as it was thought that these would be more amenable to synthesis owing to the presence of para-activating methoxy groups. With this object attempts were first made to synthesize 3 : 3′-dimethoxy-dibenzyl-methylamine by three different routes. In first of these methods, *m*-methoxybenzaldehyde was reduced to the corresponding alcohol 3-3′-dimethoxy-hydrobenzoin, m.p. 110°C, being formed as a bye-product during reduction—and the alcohol converted into the bromide by the action of hydrogen bromide. The bromide was then converted into the cyanide which could be smoothly hydrolyzed by methyl alcoholic potash to 3-methoxyphenyl acetic acid. 3 : 3′-dimethoxy-dibenzylketone was prepared by means of the Grignard reaction from the above bromide and cyanide and also by the distillation of the thorium salt of 3-methoxyphenyl acetic acid. The ketone was converted into the oxime and then reduced electrolytically when only a small amount of a basic substance was formed. In another method 3 : 3′-dimethoxy-dibenzyl malonic acid, m.p. 185-186°C was first synthesized and then converted into 3 : 3′-dimethoxy-dibenzyl acetic acid m.p. 102°C, from which the corresponding amide was prepared. The amide did not give the desired amine in good yields when Hofmann's reaction was tried. This is being further investigated.

3 : 12-dimethoxy-6 : 15 : 16 : 17-tetrahydro-ketoparaberine was synthesized in the following manner :—

m-methoxy-benzaldehyde and hippuric acid were condensed together and the azlactone hydrolyzed with ·2% sodium hydroxide solution to β-3-methoxyphenyl-α-benzoylamino-acrylic acid, m.p. 170°C, in an yield of over 90%. The latter acid was reduced to β-3-methoxy-phenyl- α-benzoylaminopropionic acid, m.p. 144°C, which was hydrolyzed to 3-methoxyphenylalanine, m.p. 215°C, in quantitative yields. The formyl derivative of 3-methoxy-phenylalanine was converted into N-formyl-3′-methoxybenzyl-3-methoxy-phenylalanine, m.p. 186–188°C, by the action of 3-methoxy-benzyl-chloride. The formyl compound was hydrolyzed to N-3′-methoxybenzyl-3-methoxy-phenylalanine, m.p. 228°C, which was converted into N-3′-methoxy-benzyl-6-methoxy-1 : 2 : 3 : 4-tetrahydroisoquinoline carboxylic acid, m.p. 233–235°C, by the action of formaldehyde. This acid, which was also synthesized from 6-methoxy-1 : 2 : 3 : 4-tetrahydroisoquinoline-3-carboxylic acid, m.p. 263-264°C, on cyclization with 70% sulphuric acid gave the keto-paraberine only in about 15% yield. The more difficult formation of the dimethoxy-keto-paraberine compared to the ease of formation of the dimethoxy tetrahydroprotoberberines lends indirect support to the conclusions of Perkin and co-workers.

140. Chaksine.

K. S. Narang *and* J. N. Ray, Lahore.

Siddiqui and Ahmed (*Proc. Ind. Acad. Sci.*, 1935, *5*, 421) isolated the iodide of an alkaloid from Cassia Absus. Various degradation products of this alkaloid have been isolated and their structure discussed.

141. Synthesis of meta-oxazine compounds.

N. W. Hirwe *and* (Miss) K. D. Gavankar, Bombay.

5-nitrosalicylamide resisted all attempts at condensation with chloral under usual conditions, but a product was obtained under pressure. The compound is a meta-oxazine derivative.

It gave an acetyl derivative. On hydrolysis with alkali it decomposed to 5-nitro salicylamide, chloroform and methyl-amine. On hydrolysis with strong aqueous ammonia, the ring is opened and 2-hydroxy-5-nitro-trichloro amino ethyl benzamide was obtained. By the action of nitrous acid it was converted into 2-hydroxy-5-nitro-trichloro hydroxy ethyl benzamide, which is a normal condensation product of chloral with 5-nitro-salicylamide not obtained directly. It can be reconverted into the above meta-oxazine compound by acetic anhydride in alkaline solution.

142. Synthesis in the alloxazine, isoalloxazine and lumazine groups.

K. Ganapathi, Bangalore.

In connection with the work on the chemotherapy of tuberculosis, the synthesis of a series of compounds of the above groups have been undertaken.

4 : 5-diaminouracil sulphate (I) condenses with phenylglyoxal hydrate to give 6- or 7-phenyllumazine, which gives the dimethyl derivative, m.p. 275°C, with diazomethane. While benzil condenses with (I) to give 6 : 7-diphenyllumazine, many disubstituted benzils were found to give only traces of the condensation products. Piperil gives 6 : 7-di (3 : 4-methylenedioxyphenyl) lumazine in poor yield. Phenylglyoxal aldoxime and also the mono-oximes of benzil, piperil and phenanthrenequinone failed to condense with 4-amino uracil.

Camphorquinone condenses with (I) to yield 2′ : 3′-camphorolumazine.

143. A study of acridine derivatives.

S. J. DAS GUPTA *and* U. BASU, Calcutta.

2-chloro-7-methoxy acridine containing a dialkylamino alkylamine side chain in position 5, has been generally found to possess an antimalarial property. With a view to study the influence of other chain or group on this acridine ring, certain acridyl amino antipyrines have already been prepared (Das Gupta and Basu, *Science and Culture*, 1937, *2*, 585); and now 2-amino-4-phynyl thiazole has been condensed with 2, 5-dichloro-7-methoxy and 2, 5, 9-trichloro-acridines to give 2-(2′-chloro-7′-methoxy-acridyl) and 2-(2′, 7′-dichloroacridyl) amino-4-phenylthiazoles, m.p. 246-47° and 269-70° respectively. They readily form monohydrochlorides of molecular weight 454 and 458·5. Similarly, 4-methyl-5-hydroxy ethyl thiazole is being fused with the above acridine derivative. As the molecular weights of the resulting condensation products lie within the limit required for an antimalarial drug (cf. Slotta and Behnisch, *Ber.* 1935, *68*, 754) it is expected that the product would be of value.

144. Acridine derivatives. Part I.

K. S. NARANG *and* J. N. RAY, Lahore.

2-methoxy-7-nitro-9-chloro acridine (the numbering followed is that of the American Chemical Society), m.p. 223°C, has been condensed with *p*-toluidine (m.p. 212°C), *p*-phenetidine (m.p. 182°C), *p*-amino acetanilide (m.p. 287°C), *n*-butylamine (m.p. 106°C) and similar other aromatic, aliphatic and heterocyclic amines. The corresponding products in each case have been further reduced to the related amines by anhydrous stannous chloride in glacial acetic acid. The 7-amino derivatives have in some cases been acylated.

These substances crystallize with a large number of the solvent molecules. In some cases, the substances had to be dried at 150–200°C in high vacuum before a correct analytical value could be obtained.

By analogy with prontosil, *p*-aminobenzene sulphonamide has been condensed with the parent substance and the product reduced to the corresponding amine and its antiseptic action against hæmolytic steptococci *in vivo* and *in vitro* is being studied.

145. Studies in the Naphthol AS series. Part II. Fastness to rubbing.

R. B. FORSTER, S. R. RAMACHANDRAN, *and* K. VANKATARAMAN, Bombay.

While the presence of the -CO-NH- group in N-AS leads to increased substantivity in comparison with β-naphthol, the various members of the series differ widely among themselves in respect of their substantivity. The precise degree of substantivity is largely a function of the colloidal state of the naphthol solution, which would in turn be presumably a function of the constitution, although there is no definable relation between constitution and the known order of substantivity. The common view that fastness to rubbing runs parallel to the substantivity of the naphthol lacked experimental verification, not only with regard to the absence of any quantitative relationship between substantivity and rubbing fastness, but (what is more important from the practical point of view) also in the sense that an unsubstantive naphthol may lead ultimately to dyeings of excellent fastness to rubbing. Provided the other stages of the dyeing process were carried out under the optimum conditions, the vital factor was the after-treatment.

In addition to the nitrogen assay method described in Part I, a more rapid qualitative procedure for the examination of rubbing fastness is outlined.

146. Condensation and coupling of methone (5 : 5-dimethyldihydroresorcinol) with some aromatic diamines and their tetrazonium salts respectively.

B. H. Iyer, Bangalore.

Chakravarti *et al* (*J. Indian Inst. Sci.*, 1931, *14A*, 141) and Iyer and Chakravarti (*J. Indian Inst. Sci.*, 1931, *14A*, 157 ; 1934, *17A*, 41) have studied the behaviour of methone towards a few aromatic aldehydes and diazonium salts of aromatic mono-amines. From these data it has been deduced that methone behaves generally in a mono-keto-mono-enol form. The azo-dyes obtained from the mono-amines have been found to be fugitive to cotton but substantive to wool and silk.

Methone has now been coupled with the tetrazonium salts of benzidine, 9-toluidine and *o*-dianisidine. The coloured substances thus obtained are being tested for their dyeing properties.

Methone has also been condensed with the above mentioned diamines and the products described (*cf.* Haas, *J.*, 1906, *89*, 187 and 387).

147. The action of diazo salts on cutch.

S. R. Ramachandran *and* K. Venkataraman, Bombay.

Perhaps the most important of the natural colouring matters which have survived is cutch or catechu, which is cheap and available in large quantities in this country. The ordinary methods of applying cutch to cotton, wool and silk in dyeing and printing are well established, but the use of catechu is restricted to 'catechu brown' or 'cutch brown' on cotton and to weighting purposes in silk dyeing. The processes now described relate to the productions of a larger variety of shades than the usual browns without impairing the admittedly excellent fastness properties of cutch dyeings. Many of the natural colouring matters of the flavone, flavanol and pyran groups contain the phloroglucin nucleus and are therefore capable of coupling with diazo salts. Cutch dyeings have now been treated with an extensive series of diazo salts leading to a range of bright and attractive shades ; another advance in the utilization of cutch is the development of padding processes in which the oxidation of catechin which hinders coupling with diazo salts is obviated. Two of the factors that influence the shade obtained from a given diazo salt are the *p*H of the developing bath and the quality of the cutch in regard to the relative contents of catechin and catechutannic acid.

A process not involving after-chroming is to use chromium acetate, alone or in admixture with sodium acetate, in the cutch-padding liquor in the diazo solution. The shades are characterized by their brightness. Some of the browns would be difficult to match by the indigoid or anthraquinone vat colours.

Cutch may be employed in conjunction with diazo salts in several styles of calico printing. The range of colourings from cutch and diazo salts in printing is naturally much more limited than in the case of the arylides of hydroxynaphthoic acid, but this limitation is a favourable factor in so far as a quiet and harmonious colour scheme is automatically accomplished.

148. Studies in indigoid dyes. Part II.

S. K. Guha, Patna.

The indigoid dyes described in this paper obtained by the condensation of 6-methyl-3-hydroxythionaphthene (Friedlander, *9*, 589 ; Auwers and Thies, *Ber.*, 1920, *53*, 2293) and aliphatic and aromatic aldehydes respectively have been compared with those of the corresponding 5-methyl derivatives (Guha, *J. Indian Chem. Soc.*, 1935, *12*, 659). It has been found that Martinet's rule (*Rev. Gen. Mat. Col.*, 1921, *25*, 17) is applicable to this series of compounds when one methyl group is present in the thionaphthene nucleus of the molecule (cf. Acenaphthenequinone and Isatin Series, Guha, *J. Indian Chem. Soc.*, 1933, *10*, 679; 1936, *13*, 94; Guha and Basu-Mullick, *ibid.*, 1934, *11*, 395; Guha, *ibid.*, 1937, *14*, 240; F.P. 693903 of 14-4-1930, *Chem. Zentr.*, 1931, *102*-I, 2944; A.P. 1850758 of 10-12-1930; *Chem. Zentr.*, 1932, *103*-II, 1374).

2:3-naphthoxythiophene (Friedlander and Woroshzow, *Annalen*, 1912, *388*, 18) and 3-chloro-, 3-bromo-, β-methoxy-acenaphthene-quinone respectively produced red-violet vat dyes. (Cf. Schwz. P.P. 107133–35 of 29-3-23; *Chem. Zentr.*, 1925, *96*-II, 860; Dutt, *Ber.*, 1934, *67*, 1326). The halogenated products imparted uniform red-violet shades on cotton from alkaline hydrosulphite vat whereas the methoxy compound produced only light violet shade (cf. 2-thionaphthene-8′-(1′-methoxy, acenaphthylene-indigo, its 5-methyl and 6-methyl derivatives, Staudinger, Goldstein and Schlenker, *Helv. Chim. Acta*, 1921, *4*, 342; Guha, *loc. cit.*).

149. Dyes derived from thiohydantoin. Part III.

G. P. Pendse, Gwalior.

Thiohydantoin possesses a reactive methylene group situated between two negative groups. Due to this reactive methylene group thiohydantoin has been previously condensed with a number of nitroso and iso-nitroso compounds, resulting in products possessing interesting dyeing properties. (Pendse and Dutt, *J. Ind. Chem. Soc.*, 1930, *7*, 953). In Part II of this series a number of aromatic aldehydes have been condensed with thiohydantoin which resulted in both acetylated and deacetylated condensation products. (Namjoshi and Dutt, *J. Indian Chem. Soc.*, 1931, *8*, 241).

To complete this series of condensations with thiohydantoin, various aliphatic and aromatic ketones have been subjected to condensation using acetic anhydride as condensing agent. Where there are more than one keto groups, it is found that generally one molecule of the ketone condenses with one molecule of thiohydantoin. A few acid anhydrides have also been condensed with thiohydantoin in presence of sulphuric acid, as the condensing agent. The condensation products have interesting dyeing properties.

150. 9.10-phenanthrathiophene-2-thionaphthene-indigo.

P. C. Dutta, Muzaffarpur.

In this paper 9-phenanthrathiofuran-1.2-dione has been condensed with 3-hydroxythionaphthene and the corresponding indigoid dye obtained. The condensation was brought about by HCl in acetic acid solution of the constituents in an atmosphere of carbon dioxide. Similar other dyes are being investigated.

151. 9-thiolphenanthrene and some of its derivatives.

P. C. Dutta, Muzaffarpur.

Except 3-thiolphenanthrene prepared by Field (*J.* 1915, 1214) the other thiolphenanthrenes are not known. So it was deemed interesting to prepare thiolphenanthrenes especially the 9-compound, which was expected to give some thio-indigoid dyes which might be of interest from the author's view point of the relation between colour and chemical constitution.

Werner and his collaborators have shown that by the action of concentrated sulphuric acid on phenanthrene three sulphonic acids—2, 3, *and 9 are produced simultaneously. Fieser (J. Amer. Chem. Soc.,* 1929, 2460) later on has introduced a method by which these sulphonic acids can be obtained in better yields and also in a more pure condition. In the present paper the preparation of 9-thiolphenanthrene and some of its derivatives—phenanthrene-9-disulphide and 9-phenanthrathiofuran-1.2-dione—have been described.

152. Azine dyes derived from 9-phenanthrathiofuran-1.2-dione.

P. C. Dutta, Muzaffarpur.

9-phenanthrathiofuran-1.2-dione prepared from 9-thiol-phenanthrene has been condensed with various ortho-diamines such as *o*-phenylene diamine, 2-chloro-4.5-toluene diamine, 2.3-diaminoquinoxalin, and 2.3-diaminophenazine to get the corresponding azines. As has already been observed, the colour of these azine dyes deepens as the number of azine rings in the molecule increases.

153. Chemical examination of the fixed oil from the seeds of *Croton Sparsiflorus*, Morung.

K. A. N. Rao *and* S. Aravamudhachari, Annamalainagar.

The seeds of this shrub which grows extensively in South Arcot District of Madras Presidency, give on extraction with CCl_4, a thick, brownish yellow oil with an unpleasant taste and odour. The oil which forms 21·4% of the seeds by weight, rapidly polymerizes on exposure to air.

The physical and chemical constants which have been determined are as follows :—

Specific gravity at 31°C : 0·9626; Refractive Index at 31°C : 1·4775 ; Saponification value : 195·4 ; Acid value : 10·1 ; Iodine value (Wijs) : 164·5; Reichert-Meissl value : 1·43; Polenske : 1·03 ; Unsaponifiable matter : 2·6% ; Solid acids : 6·5% and Liquid acids : 80·0%.

The oil is being examined with a view to identify its constituents.

154. Acidity in butter and ghee.

B. N. Banerjee *and* N. S. Doctor, Bangalore.

Lately the acidity in butter has been tried to be reduced as low as possible in a number of ways. Depending on the temperature and nature of souring, the acidity may vary from 4° to 15° in acid value. During churning, melting or evaporation a fair quantity of acidity passes into ghee and this materially affects the quality, especially Vitamin A, carotin bodies, and flavour of ghee. An acid value from 0°·3 to 2°·0 is the limit that can be permitted in a sample. A high acid value is very harmful in that it acts as a pro-oxidant and very quickly brings about loss of vitamins and flavour especially when butter or ghee is heated in cooking operations. Neutralization of acidity of cream, washing of butter, and electro-dialysis may be performed to reduce the acidity in butter or ghee and thus improve the quality of the same.

155. Use of tintometer in the detection of adulteration of butter-fat (Ghee) by agar-plate method.

K. Venkata Giri *and* P. N. Bhargava, Bangalore.

A new colorimetric method for the detection of adulteration of ghee has been described. With the help of a Lovibond Tintometer standard colour units for pure ghee and other oils have been fixed. The usefulness and the application of the method have been indicated.

156. Aroma in butter.

(MISS) R. KARNAD, Bangalore.

During recent years, more and more attention is being directed to the aroma-producing micro-organisms of butter since these play an important part in the natural flavour and aroma development in butter. The identification and estimation of the flavouring substance of butter is very essential as the market value of butter depends chiefly on its flavour.

The typical butter flavour is due, in part, to the products of fermentation in which milk sugar takes a part during the process of souring of milk. It may also come from the decomposition products of the proteins. The chemical changes are largely to be traced to the action of enzymes produced by bacteria.

There is considerable evidence to show that the aroma of butter made from ripened cream is chiefly due to small amounts of diacetyl.

Various species of lactic acid bacteria were isolated from curds by plating on whey-agar medium. There was variation in the aroma and flavour produced in milk by different acid-forming types. A new aroma-producing bacterium was isolated which gives a particularly fine butter aroma and gives a positive test for diacetyl.

Aroma and flavour development in the milk culture is best at 25–28°C. in 48 hours. A certain amount of acid must be present before the maximum flavour is developed. It is particularly interesting to note the favourable influence of yeast extract in improving the flavour. There is a marked increase in the production of diacetyl on the addition of 10 per cent. yeast extract. The flavour is also improved by the addition of small quantities (0·2 per cent.) of citrates. The volatile acidity is not increased by the addition of citric acid or citrates to the milk before inoculating the culture.

From the results obtained it can be concluded that the flavour and aroma are mostly due to diacetyl in the culture and not due to free volatile acids.

The fact that the aroma of the butter culture can be considerably improved by the addition of citrates and yeast extract seems to open up new possibilities in the field of cream ripening for butter-making.

157. Chemical examination of *India aloes, aloe vera, aloe indica*, Royle.

N. N. GHOSH *and* R. N. CHOPRA, Calcutta.

The common aloe found in Bengal and known as aloe vera does not contain any aloin, the active principle of aloes. It was found to contain very small quantities of an essential oil. a fixed oil, resin, gums, emodin, some anthraquinone derivatives and chrysophanic acid. The aloe emodin, which also has some purgative properties, is present in too small a quantity to be effective in a dose of 1 or 2 tolas of the juice or pulp. If aloe is to be administered as a hepatic stimulant and purgative, species other than the one ordinarily found in Bengal should be selected, since it was found that the total extract as well as other fractions supposed to contain the active principle failed to produce the therapeutic action of aloes.

158. Chemical examination of the roots of *Paris polyphylla*, Part I.

A. T. DUTT, N. R. CHATTERJEE, S. GHOSH, *and* R. N. CHOPRA, Calcutta.

The roots were collected from Nepal and the investigation was undertaken to find out if this Indian species contained any active glucosides found in the allied species, P. quadrifolia, analyzed in Europe. The present investigation showed the presence of about 8 per cent. of cane sugar and two glucosides, one crystalline and the other amorphous. The glucosides resembled Paridin and Paristyphuin found in P. quadrifolis and the amorphous glucoside has been found to possess strong physiological action. Further work on the glucosides is in progress.

159. The chemical and pharmacological examination of the young shoots of *Bambusa arundinacea*.

N. N. Ghosh, S. Ghosh, *and* R. N. Chopra, Calcutta.

The young shoots are used in the Indian indigenous system of medicine for their various therapeutic properties. The shoots examined were found to contain about 0·03 per cent. of HCN and about 0·23 per cent. of free benzoic acid. The juice pressed out from the shoots was found to contain 0·027 per cent. of HCN and 0·16 per cent. of free benzoic acid. The full grown green leaves of the bamboo were found to be free from HCN or benzoic acid. Aqueous solutions of the alcoholic extracts of the young shoots did not show any action against microfilaria and they did not show any emmenogogue properties. Some of the therapeutic properties ascribed to it can be explained by the presence of free HCN and benzoic acid. The other toxic principle besides HCN, as surmised by Moorthy and Stewart in their recent study, has been proved to be the free benzoic acid, the concentration being sufficient to explain the antiseptic and larvæcidal properties ascribed to it.

160. Chemical and pharmacological examination of the leaves of *Erythroxylon monogvnum*, Roxb.

N. N. Ghosh *and* R. N. Chopra, Calcutta.

The leaves are reported to have refrigerent properties and at one time it was eaten during famine for its property of allaying the pangs of hunger. The leaves were collected from the Madras Presidency and the work was undertaken to study the nature and properties of the alkaloids as well as to find out if it contains any workable quantity of cocaine or similar alkaloids. The present investigation showed that the important constituents are an essential oil and about 0·1 per cent. of alkaloids. Both acid and alkaline hydrolysis of the alkaloids gave cinnamic acid. The alkaloids produced no mydriasis or anæsthesia. A cinnamyl cocaine has got no therapeutic value and the conversion into the pharmacopœial cocaine will not prove to be an economic proposition unless the content of alkaloids can be improved by cultivation.

161. Fluorometric determination of the acid and saponification values of lac.

N: N. Murty *and* H. K. Sen, Ranchi.

The determination of the acid and saponification values of lac and its constituents is of great importance in a study of its constitution. Thymol blue has been used as an indicator in general, but in the case of dark-coloured lacs such as Burma Kusum and saponified solutions of the ether-soluble resin, this indicator fails to give a sharp end-point, and in such cases, potentiometric methods have to be employed, but the operation takes a longer time and the electrodes are susceptible to poisoning.

The orange-yellow colour of an alcoholic solution of lac changes very gradually to pink, starting at a low *p*H. Lac solutions exhibit an orange-red fluorescence when exposed to ultra-violet radiation from a mercury arc. This fluorescent colour of lac solutions changes from orange-red to green, rather sharply, near about the end-point when titrated with alkali. The possibility of using this change in the fluorescent colour for the fixing of the end point of dark-coloured lac solutions has been investigated. It was found that the method works well with comparatively less dark solutions, but in the case of very dark solutions, the addition of β-naphthol as a fluorescent indicator while titrating with alkali proved very successful.

162. Contribution to the study of the bleaching of lac. Part I. The action of the chlorine-bleach on the resin constituents of lac.

N. N. Murty, Ranchi.

A study of the chemical changes undergone by the resin constituents of lac during bleaching with hypochlorite solution has been made.

Bleaching is accompanied by an increase in the acid value and an apparent increase in the saponification value and ester value of lac. On making due allowance for the reaction between the chlorine present in bleached lac and the alcoholic potash used in saponification, real saponification and ester values can be calculated. The real saponification value of shellac is about 5 per cent. higher than that of unbleached lac, thus indicating an increase in the carboxyl groups due to oxidative changes brought about by the chlorine bleach. Aleuritic acid, a constituent of lac, does not appear to be affected by the chlorine-bleach. The hydroxyl number generally decreases slightly on bleaching.

Chlorine enters into the resin molecules, and its content increases steadily as the lac is progressively bleached, while the iodine value decreases rapidly in the beginning, and then tends to attain a minimum value. The chlorine in bleached lac exists only partly as an addition compound, the excess entering the molecule through substitution.

The chemical changes, viz. oxidation and chlorination, are brought about in the resin molecules almost immediately on the addition of the bleaching agent, but the changes in the colouring matter, although proceeding simultaneously, take some time to attain completion. The rate of absorption of bleach is quicker in poor bleaching lacs than in good Kusum lac, and is further enhanced by employing a higher temperature and lower *p*H.

When bleached lac is allowed to remain in the alkaline solution, after all the hypochlorite added has been consumed, the following changes take place, the extent of these changes depending upon the duration, temperature and *p*H :

(*a*) The chlorine content decreases, the unsaturation increases due to splitting off of HCl and the colour of the bleached lac tends to return.

(*b*) The acid value increases due to hydrolysis, consequently the ester value decreases.

(*c*) The saponification value appears to decrease slightly due probably to the splitting off of carbon dioxide from the carboxyl groups or due to removal of some acid constituent of lower molecular weight during washing.

A slower rate of attack on the resin molecules by a gradual addition of the bleaching liquor gives a product which is less prone to become insoluble than a rapidly bleached product. Higher alkalinity of the bleaching liquor and other conditions which bring about hydrolysis give a bleached lac which will have a longer life, but which will have the disadvantages of high acid value and poor colour.

163. Contribution to the study of the bleaching of lac, Part II. Factors which influence the keeping quality of bleached lac.

M. N. Murty, Ranchi.

1. The life under heat of bleached lac gives an indication of its keeping quality only in the case of extremely bad or good samples.

2. Heat and/or acid treatment of lac shortens the life of the bleached lac obtained therefrom.
3. Too rapid an addition of the bleaching liquor, or addition in one lot, is not conducive to the long life of bleached lac. After such treatment, however, the life of the bleached lac can be improved at the sacrifice of light colour by allowing it to remain in the alkaline solution for a considerable time and then carrying out the precipitation.
4. Higher concentrations of soda used in dissolving the lac act favourably on the keeping quality of bleached lac, but unfavourably on its colour.
5. The use of acetic acid for precipitation, at least towards the end of neutralization, helps in prolonging the life of bleached lac.
6. Precipitating of the slightly basic side improves the keeping quality of bleached lac.
7. Washing bleached lac precipitate with hot (especially boiling) water leads to poor keeping quality and deterioration in the colour of bleached lac.
8. Storing bleached lac in a cool place (below 10°C.) preserves both colour and solubility.
9. The higher the chlorine content in bleached lac, the faster does esterification take place in the varnish prepared out of that lac.

164. Considerations on the chemical constitution of shellac based on unsaturation.

M. VENUGOPALAN *and* H. K. SEN, Ranchi.

The separation of shellac into two distinct fractions by the treatment of solvents leaves no doubt as to the mechanical nature of the product known as shellac. It is curious, however, that the proportion of hard resin to soft resin is practically constant in almost all the samples of shellac so far examined. The variation in this ratio is so negligible that one would be tempted to postulate some chemical combination between hard and soft resins. As far as the present knowledge goes, the assumption of auxilliary valencies is all that can be put forward, but basing an analogy with lignocellulose, the adsorption or paltization of hard resin in the comparatively fluid medium of soft resin does not appear unlikely. Molecular weight determinations based on the lowering of the m.p. of camphor indicate that the mutual presence of hard and soft resins is only mechanical. Artificially prepared mixtures of soft and hard lac resins in the proportion of 30 : 70 respectively have given the same lowering of the m.p. of camphor as by an equal quantity of shellac. The molecular weights of the hard resin complex and that of the soft resin are such that the calculated value of the molecular weight of shellac and the experimentally found value agree very well. The agreement persists also if an indirect method of determining the molecular weight by the implications of any group or groups existing in shellac is taken into consideration. Thus if the iodine value of shellac is taken to be 14 and if in the whole complex the existence of one double bond is promised, then the weight of the complex is 1814. Similarly, the weight of the complex of hard resin is about 2,000 on the evidence of 13 being its iodine value. The iodine value of soft resin is approximately 18, from which a molecular weight of the complex is calculated to be 1,410, but the molecular weight determination gives the value of 460 only, showing thereby that the soft lac resin itself is probably a mixture of three component portions mechanically mixed, only one of which is the unsaturated member. The total picture, therefore, of a shellac complex is this : the hard lac portion of a molecular weight of about 2,000 admixed with soft lac resin composed of at least three molecular species the sum of the molecular weights of which is about 1410. The very important work of Gardner and his collaborators on the separation of shellac into different fractions by solvents lends additional support to this view.

Whilst the constituent acids in the soft resin are being examined, some progress as to the conception of the chemical structure of hard lac resin has been made from the proportion of aleuritic acid available from it. Aleuritic acid (trihydroxy palmitic acid) does not exist as such in this complex, but as externally or internally condensed esters and ethers. So far, aleuritic acid to the extent of 30% of hard lac has been isolated by the hydrolysis of the latter. If we assume, that at least one molecule of aleuritic acid has entered into condensation with some other unknown complex by the elimination of 1 mol. of water, the molecular weight of hard lac should be $\frac{304-18}{28} \times 100$ or 1029 which is half of that obtained by the melting point depression method. To reconcile this, one has to assume that the molecule of hard lac resin is composed of two aleuritic acid molecules, the undetermined complex having a molecular weight of 7432. It has to be assumed also that the unsaturation in the hard resin is located somewhere in this undetermined portion, with this distinction, however, from its position in the soft resin that it forms part of a whole complex, and not that it exists in a member separate from the total complex.

The nature of the linkage between aleuritic acid and the undetermined complex has not yet been definitely established beyond the fact that the carboxyl group of aleuritic acid esterifies a hydroxy group of the undetermined complex. But there is reason to believe that some of the (OH) groups in aleuritic acid are held in ether linkage with the undetermined complex. The main ground for this supposition has been the isolation by Venugopalan and Sen and Thakur, Bhowmik and Sen of auto-condensation products of aleuritic acid where, besides esterification, other linkages had to be postulated to account for free acid and saponification values—a conjecture which was further proved by the determination of acetyl values in these auto-condensation products.

165. Studies on the constitution of shellac, Part II. Condensation of aleuritic acid.

A. T. Thakur, T. P. Bhowmick, *and* H. K. Sen, Ranchi.

The auto-condensation of aleuritic acid in presence of dry HCl has been studied with the result that complexes with four to nine molecules of the acid in ester linkage have been isolated. The higher members are solid, melting and softing below 80°C. It is expected that by allowing the condensation to proceed further, resins of higher melting points could be produced.

Similar auto-condensation products by the simple heating of aleuritic acid (Venugopalan and Sen) have been isolated which have certain improved physical and chemical properties.

The authors perceive in these auto-condensations, the mechanism of the biological production of lac on the host trees through the catalysis of enzymes.

166. On aleuritic acid.

P. C. Mitter *and* P. C. Dutta, Calcutta.

The formula $CH_2OH(CH_2)_5CHOHCHOH(CH_2)_7COOH$ has been ascribed to aleuritic acid, an important constituent of shellac from analytical data. The object of this work is to verify this constitution by actual synthesis.

ω-phenoxy-pentamethylene bromide was condensed with ethyl sodioacetoacetate giving ethyl-ω-phenoxy-2-acetyl-*n*-heptylate (B.P. 180°C/3 mm.). The sodium derivative of this substance was condensed with the chloride of the half-ester of sebacic acid giving ethyl-ω-phenoxy-11-acetyl-11-carbethoxy-10-keto palmitate which on hydrolysis gives ω-phenoxy-10-keto palmitic acid, m.p. 90°C (semicarbazone m.p. 136°-137°C). It is proposed to convert the ketonic acid into ω-phenoxy-$\Delta^{9:10}$ hexadecenoic acid by the method of Robinson and Robinson (*J.C.S.*, 1925, *127*, 175). On dephenoxylation and treatment with potassium permanganate or perbenzoic acid it is expected to give aleuritic acid.

167. Recovery of insoluble lac as ester-gum.

A. K. Thakur, T. P. Bhowmick, *and* H. K. Sen, Ranchi.

Due to accumulation of shellac at the consuming end, a certain amount of accumulation of stick lac is bound to happen at the producing end. The element of speculation further plays important part in determining the period of storage of stick lac. There is deterioration on storage. The utilization of lac thus damaged or rendered insoluble is, therefore, a most important problem.

The ordinary methods of reconditioning of damaged lac do not appear to have so much prospect from the commercial point of view, as the direct conversion of such lacs into a technically usable product. The paint and varnish industry appears to be a more possible channel for the consumption of damaged lac than any specialized industry, where the quality of shellac is a determining factor of its use. Accordingly a sample of damaged insoluble lac was first acetylated by heating for 3 hours in an excess of acetic anhydride at the boiling temperature of the reagent. The resulting acetylated product was either freed from the excess of acetic anhydride and then further treated with glycerin, or in the boiling solution glycerin was added in requisite quantity and the recovery of acetic anhydride effected by distillation. The residue obtained was a viscid liquid having a free acid value—as low as 7. This product is completely soluble in alcohol, ether and other industrial solvents. On boiling in linseed oil in presence of a drier like cobalt linoleate at 200°C. for 1 hour, it makes a varnish of good drying quality and film hardness. Its use as a plasticizer is being investigated.

168. Extraction of waste lac by alcohol.

M. Rangaswami *and* H. K. Sen, Ranchi.

Further experiments on the extraction of waste lac with a view to determine, under laboratory conditions, the rates of filtration, recovery of solvent, quality of lac obtained, etc. have been undertaken with the result that under suitable conditions, the extraction of Kiri has been found to be a profitable industrial process. The erection of a pilot-plant is under consideration. A preliminary fermentation of waste lac or treatment with a saturated sodium chloride solution renders the subsequent filtration easier.

169. Development of transparent and water-resistant shellac varnish.

M. Rangaswami, Ranchi.

Previous studies on wax-free shellac varnish films indicated that the removal of wax from shellac resulted in a film which, though transparent and somewhat water-resistant, lacked the flexibility and adhesion of original shellac film. Some plasticisers like tricresyl phosphate were found to overcome this defect in a large measure but the films obtained from so plasticised shellac were found to be more affected by water as a result of plasticising. The defect, however, was overcome by the introduction of urea, thio-urea or sulphur monochloride in the plasticised products. Thus weather-resistant varnishes have been developed having suitable adhesion and flexibility.

170. The use of *p*-tolyliodochloride for determining the unsaturation of shellac.

M. VENUGOPALAN, H. K. SEN, *and* S. C. DEY, Ranchi.

P-tolyliodochloride being a more active halogenating agent than iodine monochloride, the possibility of using an acetic acid solution of this reagent in place of Wij's solution for determining iodine values has been studied in great detail and it has been found that quite reliable figures could be obtained for unsaturated fats and oils and for shellac and rosin, if this method is adopted under specified conditions. Tolyliodochloride being a more reactive substituting reagent than iodine monochloride, somewhat higher figures for iodine absorption with the former reagent are usually obtained on account of some substitution besides the addition of the double-bond taking place and a correction has to be applied for arriving at the absorption figure due to addition only. It has also been found that a mixture of 90 parts of tolyliodochloride reagent with 10 parts of a solution of iodine in acetic acid results in a more reactive reagent than the solution of tolyliodochloride alone and iodine absorption values could be obtained in 15 minutes as compared with 1 hour required with Wij's solution and 18 hours in the case of Hubl method.

171. Mycobiology of jute-stacking.

CHITTARANJAN BARAT *and* G. C. DAS GUPTA, Calcutta.

The jute yarns of commerce are not homogeneous, and it is the common practice, in order to make it approximately so, to cut out the bottom ends of the same, and after proper dressing and moistening, stack them in heaps, when some biochemical changes take place, the temperature of the stack goes high and remains so for several days, and when the yarn ends become softened and loosened to the desired extent, they are taken out and worked. A marked acidity, part of which is steam-volatile, also develops in the meantime. The period of stacking depends upon the humidity and temperature of the atmosphere to a great extent and therefore varies according to the season. The whole process is generally controlled by experience.

Bacteriological examination of the softened specimens reveals the presence of a group of symbiotic bacteria presumably of the nature of cellulose fermenting organisms described by Sen and Das Gupta (*J. Indian Chem. Soc.*, 1934, *11*, 853), as well as a mould, supposed to be *Aspergillus Fumigatus* (Fres), previously discovered by Finlow (*Memoirs of the Deptt. of Agriculture in India,* 1918, *5*, 36). The isolation of these various organisms and their action on pure cellulose as well as jute fibres are being studied with a view to adequately control the above process of jute-stacking.

172. A comparison of the properties of lignin as obtained from (1) the market, (2) from jute-fibre, and (3) from rice straw.

S. S. GUHA SIRCAR *and* J. M. SEN, Dacca.

In Part I of the investigation it is shown that all the three lignins (obtained by a modification of Willstätter method) contain methoxyl, hydroxyl and methylenedioxy groups, but in different proportions. They can be methylated and acetylated by the usual reagents. It is shown that jute-lignin presumably is formed by the polymerization of 4 units of a molecule like coniferyl alcohol or aldehyde and have a molecular weight of about 780, whereas rice-straw lignin apparently contains less methoxyl than is needed on such an assumption regarding its constitution. Commercial lignin seems to be somewhat differently constituted.

In Part II the degradation of jute-lignin according to Freudenberg's method (1937) is described and similar products, viz. veratric, veratroyl formic and iso-hemipinic acids are isolated. Under other conditions proto-catechuic acid and catechol are found. These observations support an aromatic constitution.

In Part III phenol-lignin obtained from jute is described. It is analysed for C, H, and methoxyl and from an analysis of its Ba salt a molecular weight of about 1010 is indicated.

Further work is in progress.

173. The detection and estimation of degradation in cotton, Part II. The distinction between oxycellulose and hydrocellulose.

R. B. Forster, S. M. Kaji, *and* K. Venkataraman, Bombay.

Tests for distinguishing between acidic or hydrolytic degradation and oxidative degradation of cellulose have been submitted to fresh scrutiny. The basis of the known tests is the carboxyl content of oxycellulose and its consequent affinity for metals. All, including a new variation in which copper retained by oxycellulose is detected by means of rubeanic acid, were only applicable to oxycelluloses of copper number higher than 0·5 prepared under alkaline conditions. Scholl (1911) showed that degraded cotton in presence of caustic soda was capable of reducing indanthrene yellow to the blue vat; taking advantage of the solubilisation of oxycellulose by caustic soda solution, the reaction could be utilized for distinguishing between oxycellulose and hydrocellulose and was applicable to every type of oxycellulose. An interesting feature of the combined action of vat dyes and boiling alkali on cotton was that even celluloses with very small copper number (0·1—0·2) were dyed pale shades without the addition of hydrosulphite. The copper number was not increased thereby, the aldehyde group of the terminal glucose unit apparently functioning in the active form.

With regard to coupling power with diazo salts, hydrocellulose resembled normal cellulose rather than oxycellulose and this made available a new method of distinction. From this point of view the possibility that in oxycelluloses of the type which coupled readily with diazo salts a secondary alcoholic group to the aldehydic or carboxylic group has been oxidised to the carbonyl must be considered.

174. Recent work on alcoholic fermentation. (A discourse).

Sir Arthur Harden, London.

175. Mechanism of acetic acid fermentation.

K. P. Basu *and* Md. Abdul Quader, Dacca.

The action of 18 dyestuffs on the oxidation of ethyl alcohol and acetaldehyde by *B. Orleanese* and *B. Acetic* have been studied.

It is shown that the dyestuffs which have powerful toxic action are basic in character. The acid dyestuffs cause relatively small or no inhibition.

The dyestuffs have a more powerful toxic action on the oxidation of aldehyde than of alcohol, thus showing that one enzyme oxidises alcohol to aldehyde while another oxidises aldehyde to acetic acid, i.e. two separate enzymes are involved in the two stages of oxidation of ethyl alcohol to acetic acid.

176. A micro-organism from rotten potatoes.

H. K. SEN *and* G. C. DAS GUPTA, Ranchi.

A new type of facultative anaerobic bacillus has been isolated from rotten potatoes, the optimum temperature and hydrogen ion concentration for reaction being 42°—43°C. and 8 respectively. It can ferment starch, all pentose and hexose sugars as also glycerin very readily. The products obtained by such fermentation can be grouped under two heads.

(1) Liquid products consisting of alcohol, formic, acetic, lactic and succinic acids, acetone in small quantities and still smaller quantities of acetyl methyl carbinol.

(2) Gaseous products consisting mainly of carbon dioxide and hydrogen.

The bacillus seems to belong to the same genus as Bacterium aceto-ethylicum and Macerans, but is definitely a different species. The main difference in its cultural characteristics from the other two are the following :—

(*a*) It is non-motile, whereas the other two are motile.

(*b*) It ferments galactose and laevulose both under anaerobic and aerobic conditions with either peptone or ammonium salts as the source of nitrogen. Bacillus Macerans cannot ferment galactose and laevulose at all.

(*c*) It differs also in the quantity, if not entirely in quality, of fermentation products, producing non-volatile acids such as lactic and succinic acids forming about 20–28% of the total sugar. Smaller quantities of acetone and acetyl methyl carbinol are also amongst the products of fermentation. The organism is found as rods $2-4\times 1\mu$ occurring singly, (no chains), non-motile, having spores to one side measuring $1{\cdot}5-2\times 1\mu$ gram positive.

177. Studies on the enzymes of the seeds of *Butea frondosa*, Part I. Proteolytic enzymes.

N. R. CHATTERJEE, S. GHOSH, *and* R. N. CHOPRA, Calcutta.

The seeds are said to possess definite anthelmintic action, specially against ascaris. The report that a proteolytic enzyme present in Ficus laurifolia is the anthelmintic principle of the juice led the authors to look for enzymes in Butea seeds. The present investigation has shown that the seeds contain a proteolytic enzyme which appears to be ereptic in nature. It hydrolyses peptones and casein but does not act on egg albumin or on fibrin. It liquefies gelatin. It acts best in a slightly alkaline medium but whether this is significant enough to explain the action on worms in the intestine cannot be asserted. The optimum temperature seems to be near about 40°C. Hydrocyanic acid is found to have a definite activating influence on this enzyme.

178. Studies on the enzymes of the seeds of *Butea frondosa*, Part II. Lipolytic enzyme.

N. R. CHATTERJEE, S. GHOSH, *and* R. N. CHOPRA, Calcutta.

The seeds were found to contain a lipolytic enzyme in addition to the proteolytic enzyme reported earlier. Its action has been studied on substrates like olive oil, castor oil and rape seed oil and it acts on all of these equally well. The lipase seems to act best on a slightly alkaline side and shows an optimum temperature of about 40°C. The aqueous extracts of the raw seeds as well as the defatted seeds act equally well.

179. Isolation of β-3 : 4-dihydroxyphenylalanine from the seeds of *Mucuna pruriens.*

MANAYATH DAMODARAN *and* RAGHAVIAH RAMASWAMY, Madras.

β-3 : 4-dihydroxyphenylalanine, an amino acid of great physiological interest on account of its relationship on the one hand to adrenaline and on the other to the animal pigments known as melanins, has been isolated from the seeds of Mucuna pruriens in yields amounting to 1·5% of the raw material.

Two new crystalline derivatives suitable for the identification of the amino-acid have been prepared, viz. the hydantoin and the picrolonate.

The behaviour of the substance towards reagents usually used in the determination of other biologically important substances with analogous reducing properties has been investigated. It is shown that dihydroxyphenylalanine does not interfere in the usual methods for determining ascorbic acid but is likely to do so in the estimation of thiol compounds by reactions involving the use of phospho-18-tungstic acid.

It is shown that the substance is stable under the usual conditions of acidic hydrolysis of proteins, so that, if present in proteins, it should be possible to isolate it from such hydrolysates.

180. Proteins of Indian vegetables, Part I. Drumstick.

Y. V. SREENIVASA RAU *and* V. RANGANATHAN, Bangalore.

Drumstick contains 17 per cent. protein calculated on the total nitrogen basis. Prolamine and globulin have been isolated according to standard methods and the total yield of these does not account for even 50% of the total nitrogen. This suggests that it may be due to (1) the presence of proteolastic enzymes, or (2) high percentage of non-protein nitrogen. These points are under investigation.

The prolamines and globulins have been analyzed according to the Van Slyke's procedure. The prolamin is characterized by a very low content of amide N and a high basic N, while ordinarily the prolamines are characterized by a high amide nitrogen content (about 20 to 22% expressed in terms of total N) and a low basic nitrogen content (about 5 to 8% of total N).

181. Biochemical investigation of some species of Bengal fish. Extraction and chemical analysis of the proteins from Ruhee (*Lobeo Rohita*) and Hilsa (*Clupea Ilisa*).

K. P. BASU *and* H. Ń. DE, Dacca.

The percentage of total nitrogen extractable by different solvents is 96·4 in the case of Ruhee and 93·0 in the case of Hilsa.

In both the cases the maximum amount of protein is extracted with 2% salt solution.

From Ruhee, water extract—32·4%, salt extract 5·2%, 75% alcohol —3·2% and 0·2% alkali 55·6% of total nitrogen are obtained ; the corresponding values for Hilsa are 26·8%, 9·9%, 3·2% and 53·7% respectively.

The nitrogen distribution of Ruhee and Hilsa Globulin and glutelin has been determined by the method of Van Slyke as modified by Plimmer and Rosedale.

Tyrosine and tryptophane contents of the proteins have been determined by the colorimetric method of Folin *et al.* Tryptophane contents of both Hilsa and Ruhee proteins are equal. Ruhee glutelin contain more tyrosine than the Hilsa glutelin.

Ruhee fish proteins contain more sulphur containing amino acids than the Hilsa fish proteins.

Addition of *l*-cystine to a Hilsa diet at 5% level causes growth, which in its absence is incapable of promoting any growth.

182. Action of dyestuffs, potassium cyanide and octyl alcohol on the metabolism of amino-acids in liver and kidney tissues and with liver extract.

K. P. BASU *and* MD. ABDUL QUADER, Dacca.

Both in the case of *d*-amino acid deaminase and *l*-amino acid deaminase basic dyestuffs act as poison while acidic dyestuffs are practically without any effect. Hence the active group in the dehydrogenase is acidic in nature. Probably the active group in all dehydrogenases is acidic in nature.

l-amino acid deaminase and *d*-amino acid deaminase are two distinct enzymes. KCN and octyl alcohol inhibit the oxidation of *l*-amino acids only, thus confirming the results of Krebs.

183. De-amidising action of proteolytic enzymes, Part I. Experiments on natural proteins.

MANAYATH DAMODARAN *and* V. P. ANANTHANARAYANAN, Madras.

The isolation of asparagine (Damodaran, 1932) and of glutamine (Damodaran *et al.* 1932) from enzymic digests of proteins has given direct demonstration of the existence of amide groups in the protein molecule. But before any conclusions of a quantitative nature can be drawn as to the origin of the ammonia which is an invariable product of protein hydrolysis, it is necessary to have more exact information on the deamidising activity of the proteolytic enzymes than is at present available. Such information was in the first place necessary to enable a proper choice of enzymes and conditions of experiment to be made so that hydrolysis of protein could be effected with the least amount of decomposition of the ammonia yielding complexes. Secondly it was hoped that a comparative study of the liberation of ammonia from proteins and from synthetic substrates might provide analogies from which the nature of the precursors of ammonia in the former might be inferred.

In the present paper the results of quantitative experiments on the action of pepsin, trypsin, erepsin and papain on three typical proteins, viz. casein, edestin and gliadin are described. It is shown that the three animal proteases exert no appreciable deamidising action during digestion of proteins, the ammonia formed being unconnected with enzyme action and having its origin most probably in secondary decompositions of protein cleavage products in the acidic or alkaline media employed. Papain on the other hand has either a definite deamidising action or contains a constituent which has such action.

184. De-amidising action of proteolytic enzymes, Part II. Experiments on synthetic substrates.

MANAYATH DAMODARAN *and* E. K. NARAYANAN, Madras.

The formation of ammonia by the action of pepsin, trypsin, erepsin and papain on the following substrates were studied: glycine-amide, leucine amide, asparagine, glycyl asparagine, chloracetyl asparagine, *d*-leucyl-asparagine, *dl*-leucyl-asparagine, anhydro-glycyl-asparagine.

Purified erepsin was found to act on the amide groups of glycine-amide, leucine-amide, asparagine and chloracetyl-asparagine though much more slowly than on the peptide bonds in dipeptides. It would appear from this that the specificity relations of peptidases are not so strict as much recent work especially of the Willstätter school has tended to show, being more of a quantitative than a qualitative nature. In keeping with this view is the fact that the peptide bond in chloracetylasparagine is split by erepsin contrary to accepted views on the mode of action of this enzyme. Papain showed a slight but definite de-amidising action on glycine-amide and leucine-amide.

185. The non-protein nitrogen (N.P.N.) of milks.

KAMALA BHAGVAT, Bangalore.

The N.P.N. from cow's and ass's milks have been prepared and subjected to Van Slyke's analysis. The results do not show any striking differences in composition of the two N.P.N. fractions.

An independent estimation of tyrosine, arginine and urea has been carried out.

Attention has been drawn to the three types of role which the N.P.N. will possibly play in the nutrition of animals.

186. On crystallization of the globulins from P. aconitifolius Jacq.

KAMALA BHAGVAT, Bangalore.

Crystalline globulins have been prepared from aconite bean by the methods of dilution and Am_2SO_4 saturation. The three preparations thus obtained were tested for purity and their tyrosine and tryptophane contents determined. The different preparations show some difference in their total nitrogen and tyrosine contents.

187. I. The chemical composition (Van Slyke) of the proteins and the biological values (according to balance sheet method) of *Fenugreek*, *Lathyrus sativus*, *Sorghum vulgare* and *Eleucine coracana*. II. Phosphorus in vegetable proteins.

Y. V. SREENIVASA RAU, Bangalore.

It was reported in the *Proceedings of the Indian Academy of Sciences*, Vol. I, No. 2, August, 1934, that the globulins from Lathyrus sativus prepared by different methods contained varying amounts of phosphorus. Further fractionation of the globulin has shown that the phosphorus in the globulin is present only as an impurity and not in organic combination.

188. Solubilizing action exerted by proteoclastases on the proteins of pulses.

V. RANGANATHAN *and* B. N. SASTRI, Bangalore.

In the course of a study of the digestibility of the pulse proteins in their natural environment, it was found that pepsin exerted a remarkable solubilizing (and hydrolytic) action on the proteins, while trypsin did not exert any marked influence. The extent of action exerted on different pulses is different and appears to bear a relation to the digestibility of the proteins. This observation explains the need for treating the proteins first with pepsin and subsequently with trypsin in the *in vitro* procedure for studying the digestibility of proteins.

189. Glycero- and pyrophosphatase systems of plant and animal tissues.

K. Venkata Giri, Bangalore.

The phosphatase activities of several plant materials were measured. In oil seeds the enzyme concentration is much greater than in seeds rich in proteins and starch. The ratio of the activities of pyro- and glycerophosphatases present in a large number of seeds varies widely from one plant to another. This ratio is found to be always higher than one in the case of plant materials, and less than one for the system existing in animal tissues. The experimental findings lead to the conclusion that the two phosphatases are non-identical.

190. The chemical composition and the enzymic content of Indian honey.

K. Venkata Giri, Bangalore.

The analysis of a large number of samples of pure Indian honey have been made for the purpose of purity determinations in order to set standards by which the purity of honey could readily be ascertained. The analytical figures for sucrose, glucose, lævulose, ash, moisture, acidity, diastatic number and phosphatase activity for pure samples have been determined. It has been found that there exists a correlation between the fermentation and diastatic number and phosphatase activity. The evaluation of honey and its susceptibility to fermentation on the basis of its phosphatase content is discussed.

191. Studies in the nutritive value of Indian foodstuffs. I. Enzymic digestibility of Bengal gram (*Cicer arietinum* Linn).

V. Ranganathan *and* B. N. Sastri, Bangalore.

Previous work on the digestibility of the proteins, is largely confined to the isolated proteins. The present study relates to the study of the nature and extent of the digestion accompanying the treatment of the whole meal by peptic followed by the tryptic and ereptic enzymes. The amount of non-basic nitrogen fraction in the peptic digests is low (14·6%) while the basic fraction is remarkably high (83·3%). The corresponding figures for the tryptic digests are 47·3 and 47·6 respectively. The arginine content of the peptic digests is 49·6% while that of the tryptic digests is 20·6%. The complexity of the digests as determined by the ratio total nitrogen : amino nitrogen is about 7 : 1 in the case of peptic digests while the factor for tryptic digests lies between 1 and 2 : 1.

192. The state of ascorbic acid in plant tissues.

B. C. Guha, J. C. Pal, *and* P. N. Sen-Gupta, Calcutta.

Evidence is provided in favour of the view that part of the indophenol reducing substance (ascorbic acid ?) in cabbage is present in a combined form, from which the reducing substance is released by heating. Alcoholic and ethereal extracts of cabbage also show this behaviour. There is a difference in the reducing value obtained after cold and hot treatments of cabbage suspensions and extracts with hydrogen sulphide. Further, chloroform extracts of cabbage, which do not reduce the indophenol indicator, do so after heating and the reducing substance thus produced disappears in large part on treatment with ascorbic acid oxidase.

193. Effect of vitamin C, glutathione and cysteine on the growth of certain micro-organisms.

B. C. Guha *and* G. C. Das Gupta, Calcutta.

It has been found that vitamin C, glutathione and cysteine in very small concentrations have a marked stimulating effect on the growth of the fungi—*Aspergillus niger*, *A. Oryzæ*, *A. flavus*, *Saccharomyces cerevisiæ* and *S. ellipsoideus* in a synthetic medium. On the other hand, there seemed to be an inhibiting effect on the growth of bacteria like *B. coli*, *B. subtilis* and *Aerobacter aerogenes*. The problem is being further investigated.

194. Relation between vitamin C and plant phosphatases.

K. Venkata Giri, Bangalore.

The effect of vitamin C either alone or in presence of various other substances on the enzymic splitting of phosphorus compounds has been studied with the purified enzyme from sprouted soya beans. It has been found that the oxidation of vitamin C by metallic catalysts like copper and other oxidising agents brings about the inhibition of the activity of phosphatase. The inhibition by vitamin C—Cu complex is entirely annulled by the presence of glutathione, cysteine, cystine, H_2S and other reducing agents, KCN and sodium hydrosulphite. The hydrolysis of pyro-phosphate by the enzyme is less affected by vitamin-Cu complex than that of glycerophosphate hydrolysis. This difference in the behaviour of pyrophosphate hydrolysis has been found to be due to its stabilizing action on the vitamin against catalystic oxidation. Dehydroascorbic acid either alone or in presence of cupric salt has been found to have no influence on the activity of the phosphatase. Enzymic oxidation of vitamin C does not influence the activity of the phosphatase.

Evidence is given to show that the inhibiting action of vitamin C is due to the presence of traces of Cu in water and in the reagents used for the experiments and that the antiparalysing action of thiol and disulphide compounds is due to the protection of the vitamin against oxidation by metal catalysts. The opposite actions of vitamin C and glutathione and other compounds suggest a possible means by which the action of phosphatase may be controlled in plant life.

195. Vitamin content of mangoes.

B. N. Banerjee *and* G. B. Ramasarma, Bangalore.

The vitamin A and C content of mangoes is interesting in many ways. In addition to the nutritive value, an assay of the vitamin content enables us to judge the quality of the numerous varieties that are grown in India. The effect of grafting, pollination, climate, soil, manures and weather conditions, humidity and rainfall has been investigated. The vitamin content is very variable, and depends to a certain extent on the variety, time of plucking, and stage of ripening. A few varieties are very rich in vitamins A and C. Some are very rich in vitamin C only and are well suited for preservation in the form of pickle, the vitamin value being richer than lemons or oranges. Sour and fibrous types of mangoes are not fit for table use but can be used for pulp drying.

196. The preparation and properties of polysaccharides from vibrio choleræ and related organisms.

R. W. Linton, D. L. Shrivastava, *and* S. P. Mookerji, Calcutta.

The important discovery of Heidelberger and Avery (1923) that carbohydrates are responsible for the type specificity and virulence of pneumococci, stimulated a considerable amount of research into the polysaccharides of many other bacteria. Linton and his co-workers have been making an intensive study of the immunochemistry of the vibrios during the last five years. Recently specific polysaccharides have been prepared by growing vibrios in suitable media for 72 hours at 37°C. and then working with the filtrate of such cultures, which contain the active polysaccharide. During the whole course of preparation the use of alkalis, mineral acids and other similar drastic means of purification have been scrupulously avoided. The type of medium used has been found to have a profound effect on the quality and the quantity of the polysaccharide isolated.

The polysaccharide preparations thus obtained are free from proteins, phosphates, glycogen and starch. They give strong Molisch tests but do not reduce Benedict's solution until hydrolyzed. They have great serological activity and even when diluted over 10 million times still give strong reactions with the homologous antisera. They contain nitrogen and are highly acetylated. The importance of these two points is discussed in the paper. The probable importance of a lipoid constituent has also been mentioned.

These new preparations have given rise to many interesting and important lines of work, which are being followed up.

197. Effect of *p*H, temperature and chemicals on the activity of the proteolytic enzymes in snake venoms.

B. N. GHOSH *and* M. L. KUNDU, Calcutta.

The hydrolysis of proteins and peptones by a number of snake venoms has been studied under various conditions. It is observed that the *p*H at which the proteolytic enzymes in snake venoms exhibit their optimum activity, depends to a certain extent on the nature of the substrate used. Thus, with gelatin and egg albumin as substrates, their optimum activity is at *p*H 8·2 while with casein as substrate their optimum activity is at *p*H 7·0 or *p*H 7·2. The activity of the proteolytic enzymes is inhibited by the addition of chemicals like KCN, $HgCl_2$, H_2S to the substrate solution. The maximum hydrolysis of the proteins takes place in the neighbourhood of 50°C. It appears from these experiments that the proteolytic enzymes present in the snake venoms studied are either identical with or very similar to trypsin.

Industrial Chemistry

198. Mechanism of hydrogenation in a continuous process.

S. K. K. JATKAR *and* V. T. ATHAVALE, Bangalore.

In continuation of the previous work, the kinetics of hydrogenation in a continuous process were studied by taking into account considerations based upon mass law. The velocity co-efficient at any temperature generally rises with an increase in rate, but in the case of some of the catalysts, the rise could be accounted for by the adsorption factors.

A study of the rate of change of velocity with temperature shows that there are four temperatures at which the velocity abnormally changed with a change either in the catalyst or in the oil. These temperatures are 125°C, 150°C, 175°C and 200°C respectively.

The effect of a change in the composition of the oil was studied by hydrogenating cotton seed, groundnut and olive oils. It was noted that whatever be the catalyst or the oil the velocity at 150°C is considerably high in all the cases, while at other temperatures it rises or falls depending on the catalyst and the oil used.

For cotton seed oil, though the initial velocity coefficient-temperature curve is quite smooth, an analysis of the oil shows that velocity of hydrogenation of linolein gives a maximum at 125°C, a minimum at 150°C and then increasing values up to 200°C. The olein on the other hand shows a minimum at 125°C and a maximum at 150°C and comparatively high value at 180°C. Analysis shows that linolein hydrogenates straight to stearin at 200°C.

Consideration of the apparent heats of activation for different temperatures has brought forth the following results: (1) The major portion of the activity of a catalyst is due to the presence of two active centres of nickel, each having a temperature of maximum reaction. These *temperatures are 135°C and 175°C respectively. Out of these two, the centre having* a maximum at 135°C has got a specific affinity for linolein while the other has got a specific affinity for olein, (ii) olein (independent of the active centres) reacts faster at 150°C than at other temperatures, (iii) superimposed on this is the activity due to activation of hydrogen. The activation of hydrogen is at its maximum at 110° while at 200° the solution of hydrogen is probably the only factor present.

Hydrogenation of a single substance like ethyl oleate showed two maxima at 150°C and 175°C respectively in the velocity coefficient-temperature curve, and confirmed the conclusions given in (i) and (ii) in the last paragraph.

199. Use of arsenious oxide as an opacifying agent in lead glasses and the manufacture of China glass in India.

ATMA RAM *and* LAL C. VERMAN, Calcutta.

Arsenious oxide, when added to glass batch to the extent of about 4% produces dense white opacity in high lead glasses. For the development of a proper degree of opacity, the molten glass should be allowed to cool very slowly from 700°C. If the resulting glass is suddenly cooled, very little opacity is developed. This opaque glass has been used as a decorative enamel for glass bangles. Cyrolite does not appear to be the proper opacifying agent for preparing such enamels. Addition of 0·1% of antimony oxide to the glass batch appreciably improves the gloss of the enamelled design. These glasses are somewhat similar to phosphate opals and appear to be of the 'emulsion type'. The possibilities of the manufacture of 'China Glass', an imported milk white glass used in the Indian glass bangle industry for decorating the bangles, are discussed.

200. Chemical examination of Indian pyrolusites in relation to their use in dry cell manufacture.

D. S. NAIDU *and* G. D. JOGLEKAR, Calcutta.

The paper deals with a study of the relationship between the chemical composition of pyrolusite ores and the electrical characteristics of cells prepared from them.

The results of analysis of a number of pyrolusite ores of Indian and foreign origin, and also of an artificial manganese dioxide are given.

The electrical characteristics of cells, prepared with these different pyrolusite ores and their admixtures with artificial manganese dioxide, under standardized and accurately controlled conditions, are measured under constant temperature and humidity conditions.

The electrical characteristics indicate that apart from chemical composition, water of hydration, which is present in varying proportions in these ores, plays an important part in determining their suitability as depolarizers.

The output of cells containing natural ores can be improved by admixing small proportions of artificial manganese dioxide which is comparatively rich in its water of hydration content.

201. The depolarizing action of Indian pyrolusites.

CHITTARANJAN BARAT *and* P. SEN GUPTA, Calcutta.

The depolarizing action of natural pyrolusites, appears to depend upon their chemical as well as physical compositions. On examination of various samples of natural pyrolusite as well as of fresh and exhausted dry cells, J. Meyer and R. Kanters (*Z. anorg. u. allg. Chemie*, 1930, *185*, 177) found that natural pyrolusites contain, besides MnO and MnO_2, varying quantities of Mn_2O_3 and Mn_3O_4, and during the process of cell-discharge, the dioxide present is never reduced below the stage of Mn_2O_3. This, combined with the fact that Caucasian pyrolusite and certain synthetic MnO_2, e.g. 'Manganit' (supplied by Messrs. Nikolas Branz of Germany), have greater depolarizing action than specimens with higher MnO_2 and lower Fe and Cu contents, led us to believe that the superior activity of the two previously named specimens is due to some special form of manganese oxide that possibly acts as an oxygen carrier. Investigations are being carried out with a view to determine this constituent as well as to assess the values of Singhbhum and other local varieties of pyrolusite, according to the methods described by the above authors, and to compare their compositions with those of authentic specimens of Caucasian and synthetic pyrolusites. The results, though tentative, reveal striking features, which, if properly utilized, may reasonably be expected to enhance the quality of the local 'Dioxide Ore' to a remarkable extent.

202. Some properties of Indian bentonites.

D. R. MITRA *and* A. REID, Digboi.

The chemical and physical properties of seven Indian bentonites are discussed and contrasted with those of a treated American bentonite. Of the seven, four are believed to be true bentonites ; the others are sub-bentonites. Three are mixtures of alkali and alkali-earth bentonites while the American one is a true alkali bentonite. The fourth is a calcium bentonite readily converted to the sodium form by base exchange. With one exception the Indian samples give very stable suspensions at low concentrations. The exception is the calcium bentonite which on base exchange gives very stable suspensions. *p*H values of these suspensions vary with time but eventually become constant. Six of the samples pass the suggested MgO test for bentonite ; the other, the calcium bentonite, easily passes after base exchange treatment. Thixotropy is developed to a varying extent by suspensions of the bentonites in water, that of the calcium bentonite being greatly enhanced on conversion to the sodium form. The samples show varying degrees of efficiency in increasing the viscosity of drilling fluids, none of them approaching in effectiveness the American product. The Indian bentonites can possibly be improved by suitable treatment and a few possible commercial uses are suggested.

203. Investigations into the suitability of some clays for activation.

J. L. SARIN *and* I. S. KUCKREJA, Lahore.

A number of clays from the Punjab have been studied with regard to their suitability for refining vegetable oils. In agreement with the statement in literature we found that earths with a dehydration curve (200°–600°C.) approaching a straight line are better suited for the purpose. The optimum temperature and time of heating the dehydrated earth with HCl (10%) are 110°C. and 12 hours respectively. Further work is in progress.

204. The manufacture of chromates from chrome-ion ore.

V. T. Athavale *and* S. K. K. Jatkar, Bangalore.

In continuation of the previous work on reactions in a chromate furnace, it has been found that the oxidation of the chromite occurs necessarily through the formation of the intermediate compound which requires the addition of the basic oxide in the ratio of 1 : 1·5 for Cr : Ca. The previous data on the formation of sodium, calcium and magnesium chromates also indicate the formation of the compound $9RO . 4CrO_3 . Cr_2O_3$ corresponding to 33·3 per cent. decomposition of the original chromate, in good agreement with the results obtained in the decomposition experiments In practice calcium oxide in the ratio of Cr : Ca = 1 : 1·6–1·9 is used depending upon the percentage of Cr_2O_3 in the ore and the temperature of oxidation. Addition of larger quantities of CaO is recommended when the temperature is above 1100° because the intermediate compound formed at this temperature is $17CaO . 6CrO_3 . 2Cr_2O_3$, the ratio of Cr : Ca corresponding to this compound being 1 : 1·7.

The intensity of reaction between mixtures of chromates and carbonates to form intermediate compounds increases in the order: calcium, strontium and barium, and in fact barium carbonate can be used in preference to calcium carbonate in the process of chromate manufacture.

205. Wetting agents in textile processing. Part II. Methods of estimation.

R. B. Forster, I. S. Uppal, *and* K. Venkataraman, Bombay.

The Herbig-Evans apparatus for determining wetting power has been modified, eliminating possible changes in the interval between immersion and hydroextraction and enabling the estimation of wetting power at temperatures up to 100°C. Using the new apparatus the wetting power of a series of commercial products and the influence of factors such as temperature, concentration and time of immersion were studied.

Analytical methods for estimating the active agent present in a given textile auxiliary have been examined. Processes based on the solubility of fatty alcohol sulphates and sulphonates in alcohol and on salt formation with aromatic bases such as benzimides were alike unsatisfactory for certain substances. A titrimetric method using benzidine hydrochloride, in conjunction with the study of solubility relations, is under investigation.

The reaction described in Part I (*J. Soc. Dyers Col.,* 1937, *53,* 91) has been extended to other fatty acids and aromatic amines. Substances with properties improved in certain directions (solubility in water, wetting power, ability to disperse calcium soaps) have been obtained. For the purification of the condensation products, their solubility, both as free sulphonic acids and as sodium salts, in methanol and the higher alcohols was utilized.

206. Trisodium phosphate as a textile auxiliary.

F. F. Darbary, S. R. Ramachandran, *and* K. Venkataraman, Bombay.

Working with a commercial brand of the substance containing about 99% of $Na_3PO_4, 12H_2O$, the utility of trisodium phosphate was examined as a water softener (for textile purposes), in addition to the kier for the boiling of undyed and coloured materials, as a substitute (partially and completely) for caustic soda in naphthol impregnation baths (e.g. in their application to wool and silk), in the hydrosulphite reduction of vat colours, and as a reagent (by itself and in admixture with soap, soda ash and wetting agents) for the after-treatment of cotton dyed with the insoluble azo colours. In relation to these processes, the properties of the substance, such as solubility in water at different temperatures, alterations in moisture and carbonate content on storage, behaviour towards hard water, interfacial tension between the aqueous solutions and organic solvents, and wetting power as indicated by the flotation and Herbig number tests, are recorded.

207. The recovery and use of agricultural wastes. Part II.

G. Ramarao, Bangalore.

The shelling of cashew nuts in an indigenous industry of India. India imports about 28,000 tons annually from Africa and exports the finished nuts to America. This paper deals with the destructive distillation of the partially burnt shells. Valuable products have been obtained and their yields studied.

208. Utilization of myrobolan.

S. R. Sunthankar *and* S. K. K. Jatkar, Bangalore.

We have examined the fatty oil from the myrobolan kernel. The following are the various constants of the oil which forms 36 per cent. of the kernel: sp. gravity = 0·9132, refractive index = 1·4700, sp. rotation = −0·120°, saponification value = 190·2, acid value = 3·4, iodine value = 105·1, Hehner value—insoluble fatty acids = 96 per cent., and unsaponifiable matter = 1·15 per cent.

A study of the composition of the mixed fatty acids showed that the oil consists of 58 per cent. of olein, 24 per cent. linolein and 18 per cent. saturated glycerides.

209. Industrial utilization of the grass and leaves from *Vetiveria Zizanoides* Stapf.

J. L. Sarin *and* B. S. Gupta, Lahore.

Large quantities of this grass (locally known as panni grass) are found in the Punjab, about 60 to 70 thousand maunds being available in the Hissar District alone every year. Possibilities of utilizing this grass, at present a waste product, for the manufacture of paper have been investigated. The yield of dry pulp on the weight of the grass is from 25 to 30 per cent. The paper obtained appears to be of good quality. Further work is in progress.

An important bye-product obtained from the roots of this grass is the vitivert oil. The yield obtained is 0·3 to 0·4%. The constants of the oil as determined show that the oil compares favourably with the superior Java oil in quality.

210. Preparation of saponin from *Sapindus mukorossi* Gaertn (Soapnuts).

J. L. Sarin *and* M. L. Beri, Lahore.

A method for the extraction of saponin from soapnuts has been worked out which gives chemically pure saponin in good yield. It consists in refluxing soapnut-shell powder with ethyl acetate for 3 to 5 hours. After allowing to settle for some time ethyl acetate is drawn off. Three extractions with this solvent were found to be sufficient. The ethyl acetate extract is then distilled and the pale yellow residue left behind yields saponin on refluxing first with ether sulphuric, and then with benzene. The commercial possibilities of the process are being studied.

211. A solvent extraction method for winning sandalwood oil.

A. Nagaraja Rao, Cawnpore.

Ethyl alcohol has now been employed very successfully as a solvent in the winning of sandalwood-oil from sandalwood. A simple method of utilizing the ethyl alcohol even for the recovery of oil from oleo-resin, after having used the same solvent during the first stage of the winning of the oleo-resin from sandalwood, has now been very successfully worked out by the author by treating the latter with alcohol of suitable concentrations. It has also been observed that the oil obtained by this process is in every way superior to the oil obtained by the previous methods hitherto employed in the industry.

212. A study of the 'true' and 'apparent' colloids in molasses.

A. Nagaraja Rao, Cawnpore.

The author has attempted to determine the 'true' and the 'apparent' colloids present in cane-sugar molasses from the carbonation and the sulphitation factories. While a mere lowering of the viscosity of molasses brought about by dilution brings about the separation of the 'truly' insoluble matter in molasses, a carefully controlled dialysis is necessary to determine the total amount of 'apparent colloids'. The nature of the colloids isolated from molasses under these different conditions is subjected to a detailed examination so as to yield a correct insight into their nature, which would ultimately enable the whole process of clarification in the cane-sugar industry to be worked out more completely.

213. Studies on the action of solvents on Indian coals.

R. K. Dutta Roy, Calcutta.

The action of solvents namely benzene, tetralin and pyridine on Indian coals under pressure has been studied and the function of various factors concerning the process of extraction has been discussed. A comparative study between the properties of original coal and the residual coal after extraction has been made. The tetralin extract has been resolved into solid bitumen and oil bitumen and the important role played by them in the formation of cokes has been studied. Further, individual bitumen has been resolved into its constituent parts—some definite compounds have been obtained and attempts have been made to get a clue as to the structure of coal and its best industrial applications.

214. Influence of rate of flow on the formation of ozone.

R. Krishnan *and* S. K. K. Jatkar, Bangalore.

The ozoniser consists of two double walled pyrex vessels with an annular space of about 4 mm. connected in series and operated by the ordinary single phase balanced windings of the Neon Sign Transformer. Experiments were made to study the yield of ozone for various rates of flow of oxygen.

The curve showing the yield for various rates of flow is of the asymptotic form. It is however found that for a particular rate no ozone at all is formed.

For the same rate of flow the yield of ozone is less when two ozonisers are used in series than when a single ozonizer is used, but with an increased rate of flow the yield in the two ozonisers in series is slightly greater than in the single one.

215. Equilibrium in electrodeless discharge.

S. K. K. JATKAR *and* N. B. BHATT, Bangalore.

The action of high frequency electrodeless discharge in hydrogen has been studied at low pressures in pyrex and quartz tubes. The general nature of the clean-up phenomenon observed in hydrogen has been found to agree with the observations of previous workers and the results obtained show that the gas is first adsorbed on the walls of the tube, forming a mono-molecular layer on quartz surface, from which it can partly be recovered by subsequent heating. Further loss of the gas is found to be due to formation of water vapour by its action on silicon dioxide. The water vapour is found to be dissociated to the extent of 70 per cent., by the action of the discharge.

Under the same conditions as in the case of hydrogen, oxygen disappeared in very small amount, if at all, by a discharge through it and no ozone was found to have been formed.

Carbon dioxide was found to dissociate to the extent of 25 per cent. when it was dry and free from impurities. In presence of adsorbed hydrogen the dissociation seems to occur to the extent of 75 per cent.

216. Dielectric constants of mixtures of alcohol, benzene and water.

S. K. K. JATKAR *and* (MISS) NAGAMANI SHAMA RAO, Bangalore.

We have developed a simple, single circuit for measuring the dielectric constants at different frequencies, using quartz oscillators whose frequencies were determined with great accuracy. In the case of ethyl alcohol water mixtures, the nature of the graph showing the plot of dielectric constants of the mixtures against composition indicates the existence of complexes : (1) $EtOH . 1H_2O$, (2) $EtOH . 2H_2O$, and (3) $EtOH . 3H_2O$, and confirms the conclusion arrived at in the study of the conductivity of pure soaps in mixtures of alcohol and water carried out in our laboratory.

The dielectric constants of mixtures of isoamyl alcohol and benzene show a break in the curve at a composition corresponding to the formation of the complex $1AmOH . 5C_6H_6$. The refractive index and dispersion of the mixtures also support the formation of the complex. The velocity of esterification in mixtures of isoamyl alcohol and benzene is also a minimum at this composition.

217. Oxidation of hydroxylamine sulphate and hydrochloride by means of potassium permanganate.

C. C. SHAH *and* N. V. DHAKAN, Baroda.

In the reduction of nitric acid to ammonia, hyponitrous acid has been considered as an intermediate product (*Jour. Phys. Chem.*, 1926, *30*. 1222). But it has been shown by Partington and Shah (*Jour. Chem. Soc.*, 1931, 2071) that hyponitrous acid cannot be reduced to ammonia though it can be oxidized to nitric acid to a certain extent. Leaving out nitrogen, hydroxylamine should be the first reduction product of hyponitrous acid. In order to elucidate this behaviour, experiments have been conducted to study the oxidation of hydroxylamine by potassium permanganate.

The course of the oxidation of hydroxylamine by potassium permanganate in neutral solution can be represented by the following equations :—

$$5(NH_2OH)_2H_2SO_4 + 4KMnO_4 = K_2SO_4 + 4MnSO_4 + 2KNO_2 + 2N_2O + 2N_2 + 20 \cdot H_2O$$

$$5NH_2OH . HCl + 2KMnO_4 = KCl + 2MnCl_2 + KNO_2 + N_2O + N_2 + 10H_2O.$$

In acidic solution, the course of the oxidation is represented by the following equations :—

$5(NH_2OH)_2H_2SO_4+10KMnO_2+10H_2SO_4 = 5K_2SO_4+10MnSO_4+8HNO_3 +N_2+26H_2O.$

$10NH_2OH . HCl+10KMnO_3+20HCl = 10KCl+10MnCl_2+8HNO_3+N_2 +26H_2O.$

The course of the oxidation is dependent on the concentration and the pH value of the solution. Temperature has little effect on the course of reaction.

It appears from the results so far obtained that the velocity of the oxidation reaction is very small.

218. Formation and properties of polyiodides.

M. D. Avasare *and* A. M. Trivedi, Baroda.

(i) Phase rule study of the system ammonium iodide—iodine-carbon tetrachloride at 30°C. showed the formation of a compound ammonium tri-iodide (NH_4I_3), as confirmed by quantitative examination.

Treatment of an aqueous solution of ammonium iodide of definite concentration with iodine results in the formation of ammonium penta-iodide—a very hygroscopic and unstable compound.

(ii) A detailed study of the solubility of iodine in aqueous solutions of potassium, ammonium and sodium iodides shows that (*a*) potassium tri-iodide, ammonium tri-iodide and sodium tri-iodide are only formed when the salt solutions of concentration range 0·05M to 0·7M per litre approximately, are employed; (*b*) potassium heptaiodide, ammonium heptaiodide and sodium heptaiodide are formed when the concentration of the alkali iodides, is between 4M and 5M per litre approximately; and (*c*) there is also evidence to indicate the formation of potassium penta-iodide, ammonium pentaiodide and sodium pentaiodide over the alkali iodide concentration range 1·8M to 2·8M per litre approximately.

(iii) A preliminary investigation on the reactivity of iodine in presence of alkali iodides, in a system containing iodine, alkali iodide, acetone and water has shown that the iodide is held by the alkali iodides with fairly strong molecular forces.

219. Investigations on hyponitritosulphates.

C. C. Shah *and* N. V. Dhakan, Baroda.

Pure potassium hyponitritosulphate has been successfully prepared and its chemical reactions have been studied. The following equations represent the course of its spontaneous decomposition :—

$$K_2SO_5N_2 = K_2SO_4+N_2O \quad .. \quad .. \quad .. \quad .. \quad .. \quad (1)$$

$$K_2SO_5N_2 = K_2SO_3+2NO \quad .. \quad .. \quad .. \quad .. \quad .. \quad (2)$$

The course of the reaction has been found to depend on the concentration, temperature and the pH value of the solution. In ordinary air, the solid salt decomposes, mainly according to equation (1). Anhydrous carbon dioxide has no effect upon the salt. In saturated water vapour, the salt decomposes rapidly into sulphate and nitrous oxide. The aqueous solution of the salt is unstable and decomposes according to equation (1). All kinds of acids decompose the salt in the same way, i.e. in accordance with equation (1), but alkalies appear to have a stabilizing influence on the salt.

In acidic solution, potassium hyponitrosulphate is neither oxidized by common oxidizing agents such as potassium permanganate, iodine, bromine, sodium bromate, hypoiodite, hypobromite, etc., nor reduced by reducing agents such as stannous chloride and hydrochloric acid, sodium bisulphite and hydrochloric acid, zinc and acetic acid, etc.

In alkaline solution, potassium permanganate and sodium hypochlorite oxidise it with the formation of potassium sulphate and nitric acid; all the nitrogen does not, however, get converted into nitric acid, some of it escapes as nitrous oxide.

By the action of alkaline reducing agents a very small amount of ammonia is formed and a variety of products such as hydrazine, potassium sulphite, sulphate, etc. are detected in the reduction products.

The results obtained so far show that the hyponitritosulphuric acid, probably exists in two forms:

$HO.SO_2.NO:N.OH$ .. .. (1)

$HSO_3.N.ON.OH.$ .. .. (2)

Sodium and ammonium hyponitritosulphates and the double salts of zinc, cobalt, manganese, cadmium, silver and barium have also been prepared.

220. Studies in salting out effect.

M. D. Avasare *and* C. B. Patel, Baroda.

In the studies on the salting out of iso-amyl alcohol, iso-butyl alcohol, aniline and *o*-toluidine from aqueous solutions by different salts it has been found that the hydration of a salt in solution is largely responsible for its salting out power. In addition, the ions resulting from the salts are also found to exhibit specific salting out power. Kations and anions are assigned a definite order with respect to their salting out capacity, viz.:

$Na^{\cdot} > K^{\cdot} > Li^{\cdot} > NH_4$; $Ba^{\cdot\cdot} > Ca^{\cdot\cdot}$; and $Cl' > Br' > NO'_3$

The salting-in of aniline and *o*-toluidine by ammonium nitrate is attributed to the formation of an additive compound between the solute and the salt.

221. Composition of boiled oil.

M. Goswami *and* A. Saha, Calcutta.

Conjugated double bonds in linseed oil get rearranged when boiled under commercial conditions in presence of catalysts. This view was advanced by one of us in *Science and Culture* (1935, *1*, 183) and has now been experimentally confirmed by actual determination of Dien value as defined by Kaufman and Baltes (Felte, *U. Scifen*, 1936, 93). Manganese oleate, nickel oleate, nickel rosinate have been used as catalysts and the Diene values have been determined.

SECTION OF GEOLOGY

President :—D. N. Wadia, M.A., F.G.S., F.R.G.S., F.N.I., F.R.A.S.B.

General

1. The structure of the Shali ' window ' near Simla.

W. D. West, Calcutta.

The Shali window is located immediately north-east of Simla. Two tectonic units occur, (1) an overlying slightly warped sheet composed of rocks of the Chail series, probably Pre-Cambrian in age, and (2) an underlying folded series of rocks comprising the Shali series, Madhan slates, and Tertiary beds (Eocene and Miocene).

The two units are separated by a plane of marked discordance. Thus whereas on the south side of the window the Chail series rest directly on Tertiary beds or Madhan slates, on the north side they rest on the lower part of the Shali series. In the interval, 4,000 feet of rock have disappeared.

That severe disturbance has occurred along the plane of junction of the two units is clear from the presence of small recumbent folds and thrusts in the uppermost rocks of the lower unit. Further, not only are the Chail series definitely older than the rocks that come below, but their grade of metamorphism is distinctly higher.

It is concluded that the rocks above the discordance have been forced many miles to the south along a nearly horizontal thrust plane over younger autochthonous rocks during post-Miocene times. Subsequent denudation has removed the overlying rocks and revealed the younger rocks beneath. The plane of discordance has been termed the Shali thrust. It must continue beneath Simla, and very probably joins up with the Giri thrust near Kandaghat.

2. Post-Siwalik thrusts in the Punjab sub-Himalayas.

H. M. Lahiri, Calcutta.

The paper records the occurrence of two parallel thrust-faults observed by the writer, one along the south-west base of the Siwalik range north of Rupar where the Sutlej debouches on the Hoshiarpur and Ambala plains and the other at the foot of the Nalagarh hills about fourteen miles to the north-east of the former. As the result of the first of these, the Upper Siwalik rocks north of the Sutlej are seen pushed over the horizontal Older Alluvium of the Indo-Gangetic plain. The age of this thrust is sub-Recent at the oldest. The Nalagarh thrust is probably somewhat older, with brecciated Nahan (Lower Siwalik) rocks thrust on almost undisturbed Upper Siwalik boulder-gravels and clays of the *dun* area to the south-west. This thrust is of especial interest as, at places, the Nahan beds are seen to have travelled over the boulder-gravels for considerable distance from the base of the hills.

3. Preliminary account of the Shaksgam expedition, Karakoram Range.

J. B. AUDEN, Calcutta.

An expedition under the leadership of Mr. E. Shipton, and including H. W. Tilman, M. A. Spender, topographer, and J. B. Auden, geologist, crossed the Karakoram range in May, 1937, by the West Muztag pass and descended into the Sarpo Laggo valley. From here topographical mapping and geological traverses were carried out along the Shaksgam river and over the Aghil Ranges northwards to the Yarkand river. After returning to the Sarpo Laggo valley, the Crevasse glacier, first found by Younghusband in 1889, was explored up to its head, a distance of about 30 miles from the snout. A return was made by Auden in August over the Karakoram watershed and down into the Punmah glacier. Part of the Shaksgam and Sarpo Laggo valleys had already been examined by the geologist Desio during the Spoletto expedition of 1929.

A syncline of probable Jura and Cretaceous rocks and undoubted Permo-Carboniferous occurs along the Shaksgam and southern Aghil ranges. Below the Permo-Carboniferous and extending northwards to the Yarkand river and the Kun Lun, and southwards into Baltistan, there is found a series of dark phyllites, grey-wackes and quartzites, with subordinate limestones. Red beds occur along the Zug Shaksgam and Surkwat rivers, and may be equivalent to the Tisnab series of DeTerra (Lr. Carboniferous).

Contrary to what Auden believed in 1933, he now considers it probable with Desio, that the highly metamorphosed schists, granulites and marbles which are found near Askole and up the Biafo glacier are Palæozoic in age, and contemporaneous with the less metamorphosed rocks of the Palæozoic sequence of the Aghil ranges. The metamorphism may have developed during the Tertiary along zones where the compressed geosyncline was forced downwards into levels of higher isogeotherms and more intensive granitization.

Post-Carboniferous granites and lamprophyres have invaded Permo-Carboniferous and older rocks, the latter being particularly prevalent just north of the peak of K2.

The late Cretaceous and early Tertiary volcanic suite of Dras and the Burzil valley extends over a considerable part of the Deosai plains.

4. An outline of the structure and tectonics of Peninsular India.

M. S. KRISHNAN, Calcutta.

The structural trend-lines of Peninsular India, which are the directions of the major fold-axes, are the following :—

1. The Eastern Ghats strike (N.N.E.-S.S.W. or N.E.-S.W.) extending from the Shillong Plateau to near Madras where it gradually swings round into the Nilgiris with an E.N.E.-W.S.W. trend.
2. The Godavari strike (N.W.-S.E.) seen along the Godavari and Mahanadi valleys and in the Bastar State and the neighbouring parts of the Central Provinces.
3. The Satpura strike (E.N.E.-W.S.W.) found over southern Bihar and the northern parts of the Central Provinces.
4. The Aravalli strike (N.E.-S.W.) prevalent over Rajputana and Northern Bombay. It is probably continuous with the Western Ghats down to Cape Comorin, but with a change in direction (N.N.W.-S.S.E.). Parts of Hyderabad and Mysore belong apparently to its area of influence.

The Peninsular structural lines—those of Aravalli, Satpura and Eastern Ghats—are frequently found in the Sub-Himalayan region.

The most important faults which have affected the Peninsula are :—One along the western coast and the other along the Mekran-Baluchistan coast ; those along the courses of the Narbada and the Tapti ; the Great Boundary Fault of Rajputana separating the Upper Vindhyans from the older rocks ; the Ellichpur fault ; one along the southern margin and possibly another along the northern margin of the Shillong Plateau ; those bordering the Cuddapah basins on their concave margins : the trough faults which have let down the Gondwanas into the ancient rocks and which are distributed along three linear tracts, viz., the Damodar-Son, the Mahanadi and the Godavari valleys.

5. Pleistocene glaciation in north-western India, with special reference to the erratics of the Punjab.

A. L. Coulson, Calcutta.

After considering the distribution and nature of occurrence of the long-debated erratics of the Punjab, it is concluded that if, as Cotter has suggested, a catastrophic flood was responsible for bringing them to their present positions, then that flood took place before the final dismemberment of the Indobrahm. It is suggested that the erratics more probably were transported by floes, breaking off from the snouts of glaciers and remaining unmelted sufficiently for the erratics to reach their present positions by floating down a quiet lake. Later earth movements took place which were responsible for the final dismemberment of the old Indobrahm and caused the Indus to find a new course through the Attock and Kalabagh gorges.

By comparing the evidence of Pleistocene glaciation near the Pir Panjal and in Hazara, it is obvious that the Pir Panjal must have received its major elevation after the main glaciation had occurred. Thus the general statement that there is no evidence of glaciation in the Himalaya and Sub-Himalaya below 5,000 feet must be discounted in view of the fact that elevation of these ranges has occurred after the main glaciation.

Attention is drawn to the possible part-glacial origin of certain boulder beds in the Siwaliks, as exemplified by the Bain boulder bed, considered by Morris to be derived from the melting of an ice tongue which extended eastwards from the highlands of Waziristan in late Pliocene to Pleistocene times. Record is made of the recent discovery by the author of two possible and one doubtful artefacts from the Bain boulder bed near Akbari in the Dera Ismail Khan district of the North-West Frontier Province.

6. The mid-Palæozoic land-bridge of Kashmir.

D. N. Wadia, Calcutta.

The Palæozoic sequence of North-West Himalayas contains a long mid-Palæozoic break from Devonian to Middle Carboniferous, the *hiatus* representing a more or less uninterrupted land period in N.W. Punjab, Hazara, Karnah and Gilgit region, as far north as the Pamirs. At the commencement of the Upper Carboniferous also, terrestrial conditions prevailed in Kashmir supporting a land flora of Lower Gondwana type, up to Lat. 34° 30′. There was no Uralian Ice Age in Kashmir, it being replaced by a long and intense local volcanic period. The Punjab-Kashmir land-mass must have served as a land-bridge between Angaraland and the future Gondwanaland, affording a route for the migration of terrestrial vegetation just prior to, and in the earlier stages of, the Gondwana period.

In South-East Kashmir and in the Spiti Himalayas, on the other hand, there is a continuous and conformable marine Palæozoic succession from the Cambrian to Permian, the unconformity beginning to appear west of Long. 74° 30′.

7. The structural significance of a fault in the upper Bhima series (Vindhyans) between Honhalli (Lat. 16° 44′ 55″, Long. 76° 26′ 10″), Makhtapur (Lat. 16° 45′ 30″, Long. 76° 49′ 50″), and Radewadgi (Lat. 17° 4′, Long. 76° 47′ 30″) in the Bhima basin in Gulberga district.

C. Mahadevan, Hyderabad (Deccan).

The classification of the pre-Cambrian sedimentation in the Bhima basin into a higher and a lower group is not arbitrary but there are stratigraphic reasons to support it.

A well-defined fault about 50 miles long has been traced running roughly east to west between Honhalli and Makhtapur, with a north to south trend between Makhtapur and south of Radewadgi. Besides affording clear evidence of the time-lag suggested by Bruce Foot between the Lower and Upper Bhima Series, the fault throws interesting side-light on the level oscillation in the Upper Bhima stage. The paper discusses the significance of the fault in the stratigraphy of the Bhima Series.

8. Origin of the Himalayas.

S. L. Biswas, Calcutta.

The field evidences clearly imply a crustal movement from the North. The Sliding Continent Theory provides sufficient crustal shortening for producing this mountain system and explains its structural features as well as the later development of the Southern foot-hills, marked by the series of ‘Boundary faults’. The nature of the Northern border of Peninsular India had much to do in the shaping of the range. Removal of water from the Tethys area must have submerged other parts of the earth.

9. An exhibit showing the formation of autoclastic conglomerate.

W. D. West, Calcutta.

In the Sausar series (Archæan) of the Central Provinces there occur at certain horizons what have been called by Sir Lewis Fermor ‘tabloid’ or ‘pebbloid’ schists. Detailed examination has shown that the ‘pebbles’ have been formed in rocks that were composed of alternating hard and soft beds. The harder sheets were first sheared out into flat lenticles, and were subsequently broken up and rolled out into ‘pebbles’. These may be flat, or almost spherical. They commonly contain sillimanite.

In some cases injection gneisses have been similarly affected, the injected aplite bands playing the rôle of the harder sheets and providing the ‘pebbles’.

10. Geology of Khurda, Puri district, Orissa, and its neighbourhood.

P. K. Chatterjee, Calcutta.

The area is mostly covered with alluvium and laterite. The hills near Goradharmasagar and Barunai consist of garnet-sillimanite schists (Khondalite). Near Barunai hill, an exposure of garnetiferous granitoid gneiss is found. In the neighbourhood of Kurarhmal, granite with coarse texture is visible and the same rock in its eastward extension is rich in hypersthene and is finer-grained. On the north of this hill, there is a fine-grained garnetiferous quartzo-felspathic vein found to extend in a E.N.E.-W.S.W. direction. To the south of the granite hill, there is an exposure of dioritic rocks rich in hypersthene traversed by a fairly wide quartz vein. Quartzite shows jointing well. It is associated with a thin band of psilomelane.

Laterite is worked in a quarry south of Khurdagarh, both for building purposes as well as for smelting. Psilomelane from the quartzite hillock is locally utilized by the smelters for manufacturing indigenous steel products. Clay derived as a decomposition product is used for domestic purposes.

The khondalites of this area are comparable with those of the Kalahandi State and Ceylon.

11. On a seismometric study of the Bihar earthquake of January 15, 1934 and its aftershock of January 19, 1934.

S. C. Roy, Rangoon.

An account is given in this paper of a seismometric study of the disastrous earthquake of Bihar on January 15, 1934 and of one of its aftershocks on January 19. The main conclusions are :

1. The earthquake was initiated by a minor failure near Lat. 26° 18′ N. and Long. 86° 18′ E., the time of origin of the first preliminary tremors being 8h. 43m. 21s. G.M.T. The culminating major crash, which occurred about 11s. after the initial minor rupture and about 5s. to 7s. after an intermediate stage, had its origin near Lat. 26° 21′ N. and Long. 86° 21′ E. close to Madhubani. The progression of the fractures east-north-eastwards from the minor to the major stage suggests that the stresses no longer supported at the origin of the major crash were transferred from Madhubani area more towards Sitamarhi than towards Purnea.
2. The epicentre of the aftershock of January 19 is located near Lat. 26° 24′ N. and Long. 86° 18′ E. which is close to the seismometric epicentre of the main shock.
3. A list of the aftershocks which were registered by instruments both at Alipore and Agra indicates that their frequency declined very rapidly. This rapid decline is interpreted to mean that nearly complete relief was afforded by the main shock of January 15.
4. The extra-ordinary development of long waves and the presence on the Indian seismograms of pulses characteristic of near earthquakes with shallow focal depth, suggest that the main earthquake of January 15 originated in the uppermost layer of the earth's crust.

The focal depth and the thicknesses of the uppermost and the intermediate layers of the earth's crust in Bihar have been calculated from the apparent delays in starting of the various pulses with respect to the fundamental distortional wave travelling directly from the focus to the observing station. The values found are :

Focal depth = 14·8 kms.
Thickness of Granite = 14·8 kms.
Thickness of Basalt = 25·4 kms.

It is concluded that the primary cause of the earthquake lay near the interface of the Granitic and the Basaltic layers.

Stratigraphy

12. The heavy minerals of the Assam Tertiaries.

P. Evans *and* M. A. Majeed, Digboi.

Examination by the Burmah Oil Company geologists of the 'heavy minerals' in the 50,000 feet of sedimentary rocks which make up the Tertiaries of the Assam-Arakan belt has shown that over a very wide area there is a remarkable degree of correspondence in the general character of the mineral suites. The earliest beds have a small heavy mineral content and the number of mineral species is limited. In successively younger beds there is a steady increase in the complexity of the mineral assemblages and in the total proportion of heavy minerals. The order of appearance of the various different minerals is nearly the same over a large area, and certain well-defined 'markers' formed by fairly abrupt changes in the proportions of hornblende, epidote, and some other minerals can be traced for many miles.

13. On the extent of the Niniyur division in the Trichinopoly Cretaceous area.

L. Rama Rao, Bangalore.

In the light of his recent work on the uppermost beds of the Trichinopoly Cretaceous area (L. Rama Rao and Julius Pia: On the algæ from these beds—*Pal. Ind.*, N.S., Vol. XXI, Mem. No. 4, 1936.) L. Rama Rao and C. Prasannakumar: On the flints and cherts from these beds—*Proc. Ind. Acad. Sci.*, Vol. I, No. 1, 1934) the author, in the present paper, shows that the post-Senonian transgression of the sea which gave rise to these beds (the Niniyur division) must have covered a long strip of country on the eastern side of the Trichinopoly Cretaceous area—from Authencoorchy in the north to Vilangudi in the south.

14. Unconformities in the outer Himalaya.

J. B. Auden, Calcutta.

The paper discusses the existence of unconformities in the geological succession of the Outer Himalaya between Solon and Lansdowne. The following unconformities have been recognized :—

(1) At the base of the Eocene, which lies variously on the Simla slates, Krol limestones and Tal series (Jurassic).
(2) At the base of the Tal series.
(3) At the base of the Blaini series.
(4) At the base of the Nagthat series.

The Nagthat (Jaunsar) series is pre-Blaini in age and therefore probably pre-Uralian. It is regarded as continental in origin and as equivalent to the Tanawal series of Kashmir. The unconformity at the base of the Nagthat series may be compared with that described by Wadia in north-west Kashmir and suggests a continuation to the south-east of the Kashmir-Hazara-Punjab land-mass. De Terra has described the Tisnab beds of Southern Chinese Turkestan as a continental series of rocks of Lower Carboniferous age, while Auden has found somewhat similar red rocks in the Aghil range. It seems probable that continental conditions may have prevailed during late Devonian and early Carboniferous times over a considerable area in Northern India and Southern Turkestan and gave place later to the widespread Permian marine transgression.

15. On the age of the Deccan trap as evidenced by fossil fish-remains.

S. L. Hora, Calcutta.

The systematic position of the fossil fish-remains from the infra-trappean beds at Dongargaon and from the inter-trappean beds at Takli, Paharsingha, Deothan and Kheri along with their known geological ages are tabulated. The distribution in space and time of the 10 principal types of trappean fishes is discussed, and it is concluded that these beds were probably laid down in the early Tertiaries when the land connection between India and Africa had already disappeared and when the area occupied by the beds was not very far from the sea-coast. It is further pointed out that there was probably sufficient interval between the formation of the infra- and the inter-trappean beds to permit the change from a predominantly Ganoid fauna, comprising *Lepidosteus* and *Pycnodus* of the Lameta beds at Dongargaon, to a fauna of almost exclusively Teleostean fishes, such as the Clupeidæ, the Osteoglossidæ, the Cyprinidæ and a great variety of Acanthopterygians, in the inter-trappeans at Deothan and Kheri.

From an ecological point of view one thing seems fairly certain that the conditions usually associated with a large and deep river characterized the infra-trappean period, and that by the advent of the inter-trappean period marshy conditions, usually associated with the mouths of large rivers, had set in.

16. A note on the correlation of late Tertiary marine deposits of India.

A. K. Dey, Calcutta.

A difficult problem in Indian stratigraphy is the correlation of late Tertiary marine deposits in widely separated areas. The method usually employed is based on the specific identity of the fauna. But the discrimination between species is largely dependent on the judgment and experience of the worker. The stratigraphical range of species is becoming wider than was formerly supposed. Percentage methods of correlation are of doubtful value unless ecological factors are also properly estimated. To overcome these difficulties, it is best to look, in addition, for some structural modifications undergone by a genus during its successive stages of evolution. The evolutionary stages would clearly be the best guides in correlation. The discovery of *Placenta lamellata*, n.sp., in the Neogene fauna of Quilon, showing a new stage of evolution of the genus *Placenta*, has rendered valuable aid in the correlation of the fauna.

17. A preliminary account of the petrology and age of the rocks (the Deccan trap) of Elephanta island, Bombay.

A. S. Kalapesi *and* R. N. Sukheswala, Bombay.

The island of Elephanta (18° 58′ N. : 72° 58′ 30″ E.) lies at a distance of about seven miles east of the Bombay island.

The island is entirely covered by the plateau-basalt (Deccan trap flows) which covered a large portion of Peninsular India in the beginning of the Tertiary era. The microscopic study of these rocks revealed two distinct varieties of lava flows, viz. andesite and basalt. Amygdaloidal basalt is also present. The caves are carved in this trap rock.

The main object of the present paper is to show the presence of rock types other than the normal basalt and also to deduce the geological age of the Deccan lava flows from the microscopic and analytical studies of some specimens collected from this area. The method adopted for age determination is the 'lead-ratio' method. Three different samples were analyzed for uranium, thorium and lead. Volumetric determination of uranium was carried out, while thorium was estimated gravimetrically. Lead was determined colorimetrically. Care was taken to select, as far as possible, fresh specimens for analysis. The maximum age calculated is 76 million years which agrees well with the geological age Lower Tertiary assigned to these rocks on stratigraphical and palæobotanical evidence.

18. Tertiary basalts of Bombay island.

V. S. Dubey, Benares.

The Deccan trap is divided into 3 horizons, lower, middle and upper. The Bombay rocks, especially of Malabar hill, are supposed to belong to upper flows. In the Bombay island there is also a long exposure of acid rocks. These acid rocks are later in age than the Deccan trap. But the authors found that these acid rocks are cut by basic dykes, which on analysis are found to be of similar composition to that of Malabar hill basalts. These dykes as well as the rocks of Malabar hill differ to some extent from the typical Deccan trap. The inter-trappeans below the Malabar hill flows have also yielded pebbles composed of acid rocks, found plentifully in Bombay, thus proving that the acid rocks are older than the Malabar basalts. The field evidence shows that these acid rocks are much later than the typical Deccan trap and that considerable denudation had taken place before these acid rocks were intruded. From the study of the other acid intrusions on the Western coast it appears that these acid rocks belong to Middle Tertiary age. Hence Malabar basalt, which is supposed to belong to Deccan trap, is later than these acid rocks of Middle Tertiary age.

Palæontology

19. Discovery of the Lower Trias at Na-hkam, Northern Shan States, and descriptions of its fauna.

M. R. SAHNI, Calcutta.

The author records his discovery of the first and only Lower Triassic fauna known from Burma, including the Shan States. With few exceptions the Na-hkam fauna contains the only ammonites discovered in Burma. The fauna is unique in many respects. (1) Complete absence of the calcareous brachiopods, which are extremely common in the older formations. (2) The only brachiopod present is the corneous *Lingula.* (3) Ammonites, a group of which hardly any specimens have been found in Burma, predominate. (4) Practically the only other fossils found are lamellibranchs, grastropods and annelid remains.

The fauna bears a remarkable resemblance in its general composition to the East Greenland fauna described by Dr. L. F. Spath.

The similarity is probably due to similar shallow water conditions. Affinities with the Himalayan Lower Trias are indicated by a number of forms. Amongst the ammonite genera represented are *Ophiceras* (*Glyptophiceras, Lytophiceras*), *Vishnuites, Para-Vishnuites, Hemiprionites, Juvenites, Aspenites, Kashmirites* and doubtfully *Owenites.* The first new ammonite genus of the Shan Trias—*Heronites*—is proposed.

The lower part of the Lower Trias and possibly the base of the upper part of the Lower Trias are represented. Correlation with the Himalayan Lower Trias is put forward.

The southern limit of the Lower Triassic sea was not far from Na-hkam.

There is an entire change in fauna since the deposition of the underlying Permian rocks, and this suggests a profound physiographical break near the top of the Permian, for the lowest Triassic beds appear to be represented.

20. Devonian faunas from Meso, Taungtek and the intervening area, Southern Shan States, Burma.

M. R. SAHNI, Calcutta.

The author records the discovery of Devonian faunas from the Shan States, being the only record since T. H. D. La Touche's classical find at Padaukpin, Northern Shan States, thirty-five years ago. These faunas contain the only Devonian fossils known from the Southern Shan States.

The fossils occur in the lower, dolomitic division of the Plateau Limestone which covers vast areas in the Shan States, China, Burma proper and Siam and attains an enormous thickness. The author draws attention to the almost universally unfossiliferous character of this series owing to its nearly complete dolomitization and brecciation. He emphasizes the one-sided character of these faunas. Brachiopods build up the major part, while mollusca are conspicuous by their absence. He explains this on the basis of the composition of the shell.

Amongst the fossils found are *Spirifer* (*Reticularia*) *curvatus* Schloth, *Sp.* (*Reticularia*) *aviceps* Kays., *Cyrtina heteroclyta* Defr., *Orthis* (*Schizophoria*) *striatula* Schloth., *Spirifer speciosus* Schloth. and var. *mesoensis* nov., *Atrypa reticularis* Linn., *Leptaena rhomboidalis* Wilck, *Calymene* cf. *malaungkaensis* Mansoy, etc. *Rhynchonella thannooensis* sp. nov., *Platyceras kachinensis* sp. nov., *Pleurotomaria lihsawensis* sp. nov., *Meristella palaungensis* sp. nov., etc.

The beds are divisible into two horizons, a lower, in which *Atrypa reticularis* occurs profusely, and an upper in which this well-known fossil is absent. A hard compact limestone near the top of the upper part is lithologically distinct from beds composing the other two divisions.

Older horizons may possibly be represented in the lower part of the series.

21. Palæontological study of belemnites from the Jurassic rocks of Cutch.

RAJ NATH, Benares.

While attempting to sub-divide the Jurassic rocks of Cutch into zones during field work in the year 1927, a large collection of invertebrate fossils was made by the author. The study of the belemnites has disclosed that there are two new species in the collection. The knowledge of the zonal distribution of the remaining ones adds to their stratigraphical value.

22. Corals from the Jurassic rocks of Cutch.

RAJ NATH, Benares.

During the course of field work in the year 1927 when a zonal subdivision of the Jurassic rocks of Cutch was being attempted, an extensive collection of fossils was made bed by bed. The corals in this collection form the subject-matter of this paper. Among the forms described, there is a new species (*Stylina soorkaensis*)—the only one found from the Umia beds. This new find necessitates the extension of the upper limit of the geological range of the Jurassic corals of Cutch from Argovian to Tithonian.

23. On the Infra-trappeans (Bagh beds) of Jhabua and Ali Rajpur States, Central India.

P. N. MUKERJEE, Calcutta.

During recent geological survey of the Jhabua and Ali Rajpur States of Central India, a collection of fossils was made from the Infra-trappeans (Bagh beds), the representatives of which have been already described by F. Stoliczka from the Cretaceous of South India. The discovery of some of the characteristic Upper Cretaceous forms, namely, *Protocardium pondicherriense* d'Orbigny, *Cardium* (*Trachycardium*) *incomptum* Sowerby, *Macrocallista sculpturata* (Stoliczka), *Crassinella trigonoides* (Stoliczka) and *Turritella* (*Zaria*) *multistriata* Reuss, in the Bagh beds of Central India, is of great stratigraphical importance regarding the upper limit of the age of the Bagh beds, and is in full agreement with the results obtained by Von Heune and Matley, who, from their investigation of the Dinosaurian remains in the Central Provinces, fixed the age of the Lameta beds (the fresh water equivalents of the Bagh beds) as Upper Senonian. Again, the presence of two Cenomanian forms in the collection, namely, *Grotriana* cf. *jugosa* Forbes and *Crassinella* cf. planissima (Forbes) indicates a

Cenomanian age, which has been already established by previous workers in the type area. It is, therefore concluded from the present investigations that the age of the Bagh beds range from Cenomanian to Upper Senonian.

24. On a *Palæoloxodon namadicus* mandible.

D. K. Chakravarti, Benares.

The mandibular rami and the piece of tusk described in this paper formed parts of a skeleton of an adult male Narbada Elephant, discovered in the Kankar bed of a small streamlet, flowing over the Vindhyan country in the south-eastern corner of the Allahabad district. Each ramus carries a molar, the last of the series. The molar implanted in the right ramus shows thirteen ridge-plates on the worn surface of the crown. The enamel layer is thin and as a rule free from crenulations. The piece of the tusk measures 190 mm. across the maximum diameter of its elliptical cross section and 110 mm. across the minimum. The distribution of this species in India and outside is discussed in the paper.

25. The upper Jurassic brachiopoda of the Bannu district, N.W.F.P.

M. R. Sahni, Calcutta.

This paper deals mainly with a terebratellid fauna of Upper Jurassic aspect found in the Bannu district.

Underlying this is a sandy limestone formation (Shekh Budin Limestone) containing species of *Burmirhynchia* and doubtful *Daghanirhynchia* of Callovian age, which is separated from the terebratellids by 500 feet of strata. Occurring in the same bed as the terebratellids, but about four feet above them are certain ammonites identified by Dr. L. F. Spath as of Neocomian age. This creates an anomaly owing to the Upper Jurassic affinities of the main brachiopod fauna. There is no break between the Shekh Budin Limestone and the terebratellid fauna or between the latter and the ammonites.

The age of the underlying Shekh Budin Limestone containing *Burmirhynchia* is discussed. The author disagrees with the view of the French geologists that the age of the formations containing species of *Burmirhynchia* should be lowered from the Upper Jurassic to the Norian division of the Upper Trias.

Burmirhynchia occurs in slightly older rocks in Europe and the European origin of the genus, in spite of its name, is postulated. Amongst the new species described are *Ornithella coulsoni, O. indica, O. depressa, O. ovalis, O. paralagenelis, Kingena punjabica* '*Terebratula*' *bannuensis, Rhynchonella* (*Daghanirhynchia*) *coulsoni* and *R.* (*Daghanirhynchia*) *pezuensis.*

A provisional correlation with the Oxfordian-Kimmeridgian is suggested.

The comparative value of techniques in exposing the internal structures of brachiopods is discussed.

26. Palæontological study of gastropods from the Cretaceous beds of Trichinopoly.

Raj Nath *and* M. P. Naithani, Benares.

With an idea of working out a more detailed stratigraphical sequence of the Cretaceous rocks of South India, a large collection of invertebrate fossils was made bed by bed from the outcrop of these rocks in the Trichinopoly district. The gastropods from this collection were taken up for palæontological study, which has revealed the presence of some new species. This has also helped in the revision of the geological distribution of certain species.

Mineralogy

27. Mineralization at Mawchi, Southern Shan States, Burma.

J. A. Dunn, Calcutta.

The Mawchi area consists of slates with some marbles, intruded by a large granite mass. The tin-wolfram deposits occur in each of these rock types.

The ore bodies are of cassiterite and wolfram with variable proportions of gangue minerals. The commencement of crystallization of each mineral was according to the following sequence : garnet, zoisite, fluorite, orthoclase, tourmaline, wolfram, cassiterite, beryl, phenacite, molybdenite, quartz, arsenopyrite, pyrite, sphalerite, stannite, chalcopyrite, bismuthinite, galena, scheelite, calcite, muscovite (including lepidolite), chlorite.

Scheelite is largely formed by the late replacement of wolfram. Secondary minerals include covellite and chalcocite.

The granite also contains, in places, grains of cassiterite which can be detected in thin sections.

Mineralization appears to have been continuous from a late stage in the crystallization of the granite itself, down to deposition of chlorite.

28. A chemical and mineralogical study of a new *titanium* mineral from Nellore.

N. Jayaraman *and* K. R. Krishnaswami, Bangalore.

A detailed study of the mineral comprising the black magnetic inclusions in the garnets of the schist complex of Nellore has been conducted with a view to ascertain its mineralogical and chemical significance. The paper deals with the microscopic and chemical data concerning the mineral with a description of the methods employed. The chemical and mineral compositions are given in tables. They show a very high percentage of TiO_2 which is in excess of that required for normal ilmenite. The various hypotheses so far advanced to account for this excess of TiO_2 and for the existence of systems like $FeTiO_3$-TiO_2, $FeTiO_3$-Fe_2O_3, $FeTiO_3$-Fe_3O_4 and $FeTiO_3$-Fe_3O_4-TiO_2 are discussed. From the more or less homogeneous nature of this mineral, its high titanium content, and its strongly magnetic property, it is concluded that this mineral is a well defined type, probably belonging to a new system of minerals having the composition $FeTiO_3$-Fe_3O_4-TiO_2.

29. On the origin and prospecting of mica.

S. K. Roy *and* G. C. Chattopadhyay, Dhanbad.

Origin of Pegmatites :—The authors are of opinion that the different types of pegmatites of Behar have originated from different fractions of the pegmatitic residual fluid separated from the granitic magma which gave rise to the ' dome-gneiss ' of the region.

Origin of Mica :—Workable books of mica (muscovite) are found in pegmatites carrying plagioclase (albite-andesine) as the essential and major felspathic constituent, in contrast to the barren ones of which the felspathic constituent is overwhelmingly potash felspar.

With the data available from detailed field study of several hundred workable pegmatite veins of Kodarma area the authors suggest the following characteristics to be useful in prospecting for workable veins of pegmatite :—(1) Mica in workable quantities is to be found in a pegmatite vein which carries plagioclase as one of the major constituents of the 'Reti', (2) such a pegmatite vein must possess a conspicuous core of massive quartz, (3) the pegmatites should carry such minerals as Tourmaline, Beryl, Apatite, etc., (4) in such a pegmatite vein the occurrence of workable muscovite varies from place to place but during development work the sure presence of muscovite in the proximity is revealed by the appearance of the transparent grey 'Kajra' quartz in the 'Reti', (5) 'Jogni' in Reti is a very favourable sign for the occurrence of workable muscovite lodes in the proximity.

Petrology

30. On the origin and correlation of the cordierite hypersthene rocks and their associated basic granulites from Bidaloti (Mysore State).

B. Rama Rao *and* T. P. Krishnachar, Bangalore.

Drawing attention to the somewhat restricted occurrence of rock types which contain cordierite and hypersthene in association and to the diverse ways in which they might originate, the authors of the paper give a detailed account of the mineralogical, chemical and field characters of the cordierite hypersthene rocks and the basic granulites associated with them as exposed in the vicinity of Bidaloti (13° 31′ N.; 77° 17′ 30″ E.) in Mysore. From a careful investigation on the genesis of these rock types the authors conclude that the cordierite hypersthene rocks are clearly sedimentary in origin, but as a result of repeated metamorphism brought about by several igneous intrusions, have lost not only their original structural characters, but also have been considerably modified in their chemical composition. Due to an enrichment in magnesia and other constituents, the modified composition of the original sediments as reflected in their metamorphosed types, the present-day cordierite hypersthene rocks, correspond neither to that of argillitic sediments nor to that of basic igneous rocks and consequently the several diagnostic chemical criteria fail to give consistent clues to detect their original nature. However, the textural characters of these rocks, though ill preserved, give a sufficient indication to their original sedimentary character.

Of the basic granulites associated with them, the dark 'hornblende granulites' are found to be of igneous origin and intrusive into the sediments. The pyroxene granulites, the hypersthene-bearing types of which are comparable in mineral composition to the well-known charnockites, are found to have been formed from the contamination of the basic intrusive which gave rise to the 'hornblende granulites', with the original argillitic sediments, from a process akin to regenerative reaction. Both the hornblende granulite and the pyroxene granulite including the hypersthene-bearing types, are shown to be the modified phases of one and the same rock and therefore of the same age. They are both older than the granitic gneiss.

The effects of contamination in the formation of some of the abnormal rock types of the region have also been briefly touched upon in this paper.

31. Assimilation and the evolution of hypersthene-bearing rocks in Bastar State, Central Provinces.

P. K. Ghosh, Calcutta.

The assimilation of a basic diopsidic rock by a highly alkaline magma has produced the following stages in the evolution of hypersthene-bearing rocks :—

Stage I. Formation of hypersthene and garnet from diopside and anorthite molecules as follows :—

$$\overset{\text{Diopside}}{2\left[\begin{array}{l}\mathrm{CaO(MgFe)O.}\\ \mathrm{2SiO_2}\end{array}\right]} + \overset{\text{Anorthite}}{\left[\begin{array}{l}\mathrm{CaO.Al_2O_3.}\\ \mathrm{2SiO_2}\end{array}\right]} + \overset{\text{Silica}}{\mathrm{SiO_2}} = \overset{\text{Garnet}}{\left[\begin{array}{l}\mathrm{3CaO.Al_2O_3.}\\ \mathrm{3SiO_2}\end{array}\right]} + \overset{\text{Hypersthene}}{2\left[\begin{array}{l}\mathrm{(MgFe)O.}\\ \mathrm{2SiO_2}\end{array}\right]}.$$

The resulting rock resembles a basic charnockite.

Stage II. Previously mentioned minerals + yellow hornblende passing marginally into a blue species (? more sodic variety) and plagioclase of medium basicity. The rock resembles an intermediate charnockite.

Stage III. A completely heterogenous type of rock, consisting of the basic constituents mentioned above embedded in a mesostasis of acid plagioclase, quartz, biotite and a little orthoclase. This stage represents a link in the chain of evolution of the final acid type (Stage IV).

Stage IV. Relative enrichment of potash, leading to the greater development of potash felspars and biotite than in the earlier type. Hypersthene is present in a smaller amount. The rock is similar in character to the acid charnockite.

It is suggested that possibly a similar mode of origin may be ascribed to other charnockite masses.

32. Further study of Mylliem granite, Khasi hills, Assam.

N. N. CHATTERJEE, Calcutta.

A preliminary account of the Mylliem granite was communicated to the 24th session of the Indian Science Congress (1937). The present paper deals with the structural features in some detail and the various processes of differentiation and assimilation that brought about the different varieties in the Mylliem granite. Of the structural features (i) weathering, (ii) joints, (iii) flow of felspar phenocrysts, (iv) veins, and (v) displacements have been discussed. There are typical tension fractures filled up in many cases by aplites, pegmatites and quartz veins. Sheet or horizontal jointing has developed fairly well. NE-SW joint is also present. The phenocrysts of felspar are found to flow in N-S with varying angles of pitch. The pitch is more northerly than in any other direction. There is also E-W and NE-SW flow. There are displacements in the granite as evidenced by the shifting of aplite and tourmaline veins and by fracturing and shifting of felspar phenocrysts and xenolith blocks. By the influence of hyperfusible constituents tourmaline-bearing granite, muscovite granite and early pegmatitic granite have been formed. Partly crystalline magma has subsequently been filter-pressed and late pegmatites and aplites have been formed. Assimilation process and formation of hybrid rocks have been discussed in the paper.

33. Permanganate oxidation of some of the Indian coals.

B. B. NIYOGI, Dhanbad.

The present paper is a preliminary attempt to measure the reactivity of coal towards permanganate oxidation. Reactivity towards alkaline permanganate is measurable either by determining the change in solubility of the ulmin or by determining the amount of oxidizing agent used under standard conditions. Alkaline permanganate solution has been used, very recently, by Heathcoat and Francis to measure the rank of coal (Fuel, Vol. XI, No. 5, 1932, page 174).

In the present work sixteen samples of coal and one sample of lignite have been examined The results show that there is a relation between the Fuel Ratio and the ratio of *oxygen used* to the *solubility produced.* Lignite at one extreme shows great reactivity towards alkaline permanganate, indicating the maximum solubility. The solubility produced for samples from the Barakar Series varies from 53% to 59·6% whereas for other samples the solubility varies from 78% to 84% (calculated on the pure coal substance). The Tertiary coals show a still higher solubility. This preliminary investigation has indicated what appears to be a criterion for rank identification. Vitrain bands selected from the samples may prove to be the most appropriate coal material to use in such investigations, because of its homogeneity and ease of acquisition and handling.

34. Micro-structure of some Indian fusains.

N. N. CHATTERJEE, Calcutta.

The specimens of fusain were obtained from (i) Talchir coalfield, (ii) Lalmatia, Hurra, and Jilbari coalfields, Rajmahal Hills, (iii) 13 and 14 seam, Jharia coalfield, (iv) Borodhemo and Borachak coal, Raniganj field, and (v) Tertiary coal from Salt Range. The Rajmahal Hills and Talchir field specimens are composed of abundant fusain patches. These specimens are found to contain several rows of bordered pits (uni-seriate, bi-seriate, poly-seriate, etc.). Measurements of tracheids were carefully made and several uni-seriate tracheids in the Gondwana specimens are found to be on an average 40μ (1μ = ·001 mm.) across the pits (outer ring) and 10μ in diameter. These characters suggest the presence of rich gymnospermous wood in the Gondwana fusain patches. Examination of a few polished blocks of Raniganj coal containing fusain patches by reflected light lends support to the above features. The Salt Range fusain on examination is found to contain only insignificant amount of tracheid with bordered pits. Several fragments of wood could however be found in transverse section showing water conducting cavities (vessels) of different sizes arranged in more or less regular manner. These are supposed to be fragments of angiospermous wood.

Economic Geology

35. A new method of the quantitative estimation of gold in poor grade gold lodes.

S. K. ROY *and* K. K. DUTTA, Dhanbad.

The rusty brown, poor grade pyritic gold-quartz ores of Lowa (Manbhum) did not respond satisfactorily to the known methods of assaying gold given in literature, excepting to the dry assay. But use of dry assay is prevented by its prohibitive cost.

The method that has been devised entails a combination of well-known wet and dry procedures and has been found to be useful to accurately determine the presence of even 0·1 cwt. of gold in an assay ton of sample. Bromine and chlorine which dissolves gold easily were utilized as solvents. Previously roasted pyritic gold ore in contact with bromine water reacts as follows :—

$$2Au + 3Br_2 = 2AuBr_3$$

Bromine was then replaced by chlorine by the use of $KMnO_4$ and HCl, and the gold bromide was changed into chloride.

$$2AuBr_3 + 3Cl_2 = 2AuCl_3 + 3Br_2.$$

This gold chloride is then treated with Pb-acetate and zinc granules, evaporated and then scorified giving the bullion. The use of Br may be avoided by passing Cl gas only, through powdered ore moistened with water.

Precautions necessary in this method are that the bromine must be quite in excess of the ore, the $KMnO_4$ must be thoroughly dissolved in the solution Before HCl is added, evaporation should be carried out on a water bath in a lead basin and a large amount of borax should be used in scorification so that the slag may be very thin, fluid and glassy.

36. A study of the composition of the ashes of some Indian coals and lignites.

J. N. MAJUMDAR, Dhanbad.

The chemical composition of ashes of 49 samples of coals from Jharia, Raniganj, Talcher, Kargali (Bomaro field), Jainty (Jainty field), Singareni (Hyderabad), Pench Valley (Central Provinces), Assam, and lignites from Palana (Bikaner), and Kashmir have been studied. Distinction has been drawn between the compositions of ashes of Tertiary coals and those of other coals. Differences in percentages of ash, and of sulphur and phosphorus contents of the coals and lignites have been studied. In these respects striking differences have been observed. The most striking difference between the characters of ashes of Tertiary coals and those of other coals is the presence in ashes from Tertiary coals of very low percentage of silica, alumina and titanium oxide (absent in most of the cases) and high percentages of iron, lime, sulphur and alkalies suggesting their easy fusibility. There are striking differences in the colour of ashes from different coals and lignites. Aqueous solutions of coals of Tertiary formation have been found to differ very considerably from those of other coals.

37. Auriferous alluvium of the Gurma *nadi*, Manbhum.

B. C. ROY *and* A. K. DEY, Calcutta.

The paper embodies the results of field and laboratory investigations of some auriferous alluvials collected from the bed of the Gurma *nadi*, near Dhadka, in Manbhum district. Samples were collected from various localities and concentrated by panning. After a preliminary elimination of the magnetic portion of the concentrate, the non-magnetic portion was treated with Thoulet (Sp.Gr. 2·8) solution. The heavy residue was further fractionated by Rohrbach (Sp. Gr. 3·35) solution. The mineral assemblage is suggestive of the presence of auriferous tourmaline-quartz veins and a metamorphic suite of rocks in the drainage area. It appears that the gold bearing veins represent a pneumatolytic-hydrothermal facies—probably a rest solution of differentiation of a granite magma. A detailed systematic examination of the detritals is required before any idea of the gold concentration could be ascertained.

38. Study of some varieties of Indian asbestos.

M. P. NETARWALA *and* H. S. DALAL, Benares.

The authors in this paper mention the occurrence of asbestos in different localities of India. Some of the varieties have been analyzed and their resistance to concentrated hydrochloric and sulphuric acids have been determined. From the study, the authors conclude that the asbestos of Seraikelā State, Bihar and Orissa and of Dungarpur State, Rajputana is of the amphibole variety and it could be used for chemical filtration in the manufactures of washers and rings, etc. as a lagging material. The chrysotile of Kurrana, Punjab and of Basi, Rajputana could be spun into cloth, twine and rope and then put to various uses. The asbestos of Kuruntia, Ajmer Merwara could be utilized for making asbestos cement.

39. Dykes in the Deccan trap and their influence on underground water.

G. G. NARKE, Poona.

In this paper the author has described the formation of a sand basin in the bed of the Karha river between Morgaon and Karhati villages in the Poona District due to the presence of a hard compact dyke at Karhati and the sinking of wells in the neighbourhood, to bring under cultivation about 150 acres of waste *forest land.*

40. The uppermost ferruginous flow in the Deccan trap and its utility as a water bearing formation on top of the hill forts of the Western Ghats.

G. G. NARKE, Poona.

The author has described the occurrence of water at about 2,400 feet above the surrounding plains on top of Singhgarh Fort, 14 miles distant from Poona and other places in the Deccan.

SECTION OF GEOGRAPHY AND GEODESY

President :—A. M. Heron, D.Sc., F.G.S., F.R.G.S., F.R.S.E., F.N.I., F.R.A.S.B.

1. Types of movements of people in the Cauvery delta.

S. Muthukrishna Ayyar, Madras.

1. A general survey of motives for migration in different ages to serve as a sort of back-ground for the investigation.

2. Classification of the types of movements in the selected area under three main heads, *viz.*, movements (*a*) into, (*b*) within and (*c*) from the region.

3. The geographical and other causes of these movements—past and present.

Early attractions for immigration—

1. Natural irrigation facilities.
2. Canals and anicuts.
3. Rainfall in the growing season (rice plant).
4. Annual silt carried by the river.
5. Stable and benevolent government.
6. (Protection against inroads.)
7. Patronage of arts, crafts and learning.
8. State and private charities.
9. Flourishing ports, etc.

Causes of the present day outward flow of population—

1. Maximum use of resources (irrigational).
2. Inability to find food for the growing population.
3. Imprudence, easy-going life and high standard of living.
4. The British rule, English education and advance in communications, wide outlook and high ambition.
5. Soil deterioration.
6. Small holdings.
7. Enforced idleness for six months a year.
8. Difficulty in the change of crops, etc.

4. Comparison with other deltas, Malabar and Tinnevelly.

5. The social and the economic effects.

(*a*) Deserted villages.
(*b*) Poverty, disease and premature death.
(*c*) Growth of urban population.
(*d*) Low fertility, slow increase of population.
(*e*) Luxuries, litigation and absentee landlords, etc.

6. A typical delta village (surveyed).

7. Remedial measures for counteracting the adverse effects,—how to send people back to the villages.

2. A geographical study of the Ranchi plateau.

S. C. CHATTERJEE, Ranchi.

In this paper the geological structure of the plateau is studied in relation to the morphology, followed by a study of its climate, soil, vegetation, land utilization, and distribution of population.

3. The shifting of population-centres in Bengal.

S. P. CHATTERJEE *and* S. K. BOSE, Calcutta.

Geographical factors leading to the development of a number of towns in modern times at the expense of old towns have been studied. This migration of population has resulted in marked changes in life and activities of the people.

4. Geographical interpretation of the distribution of population in two typical districts in India.

S. P. CHATTERJEE *and* A. GANGULI, Calcutta.

Two typical districts—Nadia and Tinnevelly—are selected and geographical factors determining density of population in different parts of the districts have been studied. Anomaly in the distribution of population in some parts of the districts has been traced to the decline of industry and failure to respond to the changed environment.

5. Natural regions in India.

S. P. CHATTERJEE, Calcutta.

The classification is based on the character of the forest flora, surface relief and climate. Man's adjustment to the physical environment has been shown in each of the natural regions.

6. Place names in Tamil country.

C. M. RAMACHANDRA CHETTIAR, Coimbatore.

A study of place names is interesting and instructive in every aspect of human life. History, geography and other human sciences find a large treasure in the current names of places when analyzed and studied with proper perspective.

1. *Natural divisions*: A particular name of a division always carried a particular set of ideas regarding the people, flora, fauna, vocations, customs and manners. The conventional divisions according to the Tamil poets were :—

1. Hilly region—Kurinji.
2. Pastoral tracts—Mullai.
3. River valleys—Marudam.
4. Desert country—Palai.
5. Sea-side region—Neithal.

When analyzed the prefix of each name denotes the origin and the suffix the nature of the country. The place names testify the above classification.

2. *Inhabitants*: The infusion of Kanarese and Telugus into the pure Tamil country and their influence in all human affairs. This is indicated by the ratio of Kanarese and Telugu suffixes with the Tamilian in place names.

3. *Occupation*: Suffixes are also found according to the occupations of the people. The predominant occupations were agriculture, handicrafts, trade and commerce, pasture, forestry, etc.

4. *Administration*: Villages and tracts were divided for purpose of administration and suitable prefixes were adopted for zamin, inam, agraharam zagir or ryotwari.

5. *Historical*: Prefixes and suffixes relate to innumerable historical facts, e.g. origin of places and other historical incidents.

6. *Other Aspects*: A good number of place names have religious, mythical, geographical and geological origin. Curiously even geological origins are found as Kanjamalai (Gold), etc. Some are of pure Tamil origin and some are of Sanskrit origin which denote clear cleavage in the infusion of civilizations.

7. *Local Tradition and Dialects*: Certain names are peculiar to certain districts and even dialects are represented. Archaic names sometimes persist.

7. Post-Mesozoic movements in Chhota Nagpur.

J. A. DUNN, Calcutta.

An early Tertiary peneplain, now represented by the Neturhat plateau and other residuals, was lifted in early Tertiary times about 1,000 feet in the centre of Chhota Nagpur, with a tilt to the north-east towards the Rajmahal hills.

Between the middle and late Tertiary there was a further uplift of perhaps 1,000 feet, reaching a maximum on the Ranchi plateau and its dissected extension to the south. This uplift resulted in a tilt to the north and north-east from the Hazaribagh plateau. Along the Son river the northern edge of the uplift was abrupt, as also along the eastern edge of the Ranchi plateau.

In South-East Chhota Nagpur (South Dhalbhum) further uplift, amounting to some 300 feet, took place after an interval which had permitted the development of quite a well-defined peneplain—this upwarp was rather abrupt along the Subarnarekha river.

From the south-eastern part of this region extending to the coast, a general rise, amounting to a maximum of 400 feet, has continued down to the present day.

The movement has, therefore, been cumulative in central and south Chhota Nagpur; there has been little or no apparent differential movement in the region of the Rajmahal hills, whereas further north the Gangetic plain has been a region of apparently persistent depression.

8. The great divide.

C. B. FAWCETT, London.

'The Great Divide' is the belt of deserts across the old world, from the Sahara north-eastward to the tundra of East Siberia. Because of its climates, and its geographical position, this zone has been the dividing area between the agricultural regions, with their dense sedentary populations and developed civilizations.

The paper attempts a review of the characteristic features of this 'zone of separation' and of its relative importance in the past and to-day.

9. Geography and the scientific movement.

H. J. FLEURE, Manchester.

Darwin's view of life, as in process of continued mutual reaction with environment, pressed forward study of evolution of relations of human groups to environments. Results show that group life is basic fact and that self-conscious individuality appears to varying extents in various stages of groups evolution. Geography on the human side may, therefore, be called Human Ecology or Applied Darwinism.

10. The origin of the great river-gorges of the Himalayas as evidenced by the distribution of fishes.

S. L. HORA, Calcutta.

A summary of views regarding the origin of the great river-gorges of the Himalayas is given. It is pointed out that the fish faunas on the northern and the southern slopes of the Himalayas are quite distinct, and that an explanation of this fact is to be found in the origin and the present form of the Himalayas. The evolution of the present-day drainage pattern of the southern face of the Himalayas is traced from the evidence afforded by the distribution of fishes, and it is concluded that the early drainage of the Himalayas was from east to west along both the faces, and that it underwent considerable changes due to differential orogenic movements in the region west of the Tista drainage system and in the Potwar Plateau. The distinctness of the northern and the southern fish faunas of the Himalayas favours the view that at an early age the Himalayas had ordinary consequent drainage, the rivers flowing north and south of the crest. The distribution of fishes along the southern face indicates that the rise of the Himalayas occurred in sharp, sometimes localized, earth-movements, so that the fishes always remained in the valleys and were unable to colonize the precipitous higher reaches. A reference is also made to the influence of the monsoons on the southern face, and to the process of river-captures that probably played a great part in the distribution of fishes from the east to the west. From the evidence presented, it is concluded that the south-flowing rivers, through vigorous erosion, captured the rivers on the Tibetan side of the range.

11. Environmental and cultural changes of pre-historic Man near Madras.

V. D. KRISHNASWAMI, Madras.

The author, after selecting a promising area in the Kortalayar valley, joined the Yale-Cambridge North Indian Expedition.

Their work over, T. T. Paterson and H. J. Drummond came over to his area. Four terraces were then traced and mapped out, and the connected lithic industries investigated at Cambridge along with the North Indian Collections.

The conclusions based upon limited field work were :—

1. A boulder conglomerate bed, resting on Jurassic shales, underlies the laterite peneplain—T_0;
2. T_1 cuts into the laterite peneplain;
3. T_2 (well developed at Attirampakkam) is an Acheulean site;
4. T_4 (seen best near Erumaivettipalaiam) is alluvial.

There appear to have been two major pluvial periods separated by a dry phase and then a minor wet phase—corroborating the results of Burkitt and Cammiade in the Upper Kistna.

A progressive evolution in technique and typology of the industries is disclosed and the Clacton type invariably precedes the Levallois. The maximum development here corresponds in the opinion of L'abbe Breuil to the Combe Capelle stage. Cultural stages present marked similarity to the African and Burkitt has in a brilliant paper insisted on the importance of investigating its causes.

The flake industry appears to have been as well developed in South India as in Java, though Callenfels and Koenigswald have thought otherwise.

The results make it probable that the Kistna and Godavari valleys would yield quite similar ones.

12. Population and its distribution in Kerala.

GEORGE KURIYAN, Madras.

Kerala is one of the most densely peopled parts of the world, with an average density of 660·9 persons per square mile. The region is essentially agricultural. This high density could only be accounted for by the exceptional productivity of the region. Rainfall seems to have very little influence on density. It depends on the proportion which the land cultivated with food and money crops bears to the gross cultivated area. Every person has on the average about 0·4 acres of cultivated land, while every person supported by agriculture has 0·9 acres of cultivated land, both of which are extremely low figures. The possibilities of extending the acreage under cultivation are not great. The average yield is very low and scientific methods could not be easily adopted owing to the small holdings. The distribution of population of Kerala is different from the adjoining Tamil Nad; the settlements are dispersed; there is no village in the strict sense of the term; but its town is a real urban agglomeration. The average rate of growth of population during the last census decade within this region has also been phenomenal; Travancore, due to the better utilization of its highlands, has registered the greatest growth.

13. Urban centres in Kerala.

GEORGE KURIYAN, Madras.

In any country it would be difficult to condense into a formula the attributes of a town and in Kerala, where the village represents in essence an extent of country throughout which isolated houses are dotted, certainly no hard and fast line exists. The most important aspect of a town should be the character of the population and the relative density of the dwellings. An urban area is one where the majority of the population follow non-agricultural occupations. On the functional basis, it is possible to classify the towns into (1) Capitals, (2) Industrial towns, (3) Commercial towns, (4) Market towns, (5) Religious towns, (6) Agricultural and distributive towns. There are 30 urban centres in Kerala. More than 75% of the total urban population live in the larger urban centres with a population in excess of 20,000. The total urban population forms only 8·5% of the total population and this indicates that Kerala is far from being urban. The Mahomedan element in the towns is greater than in the rural parts while the contrary is true of the Hindus. This is due to the difference in occupation of these communities. In Kerala the towns are mostly confined to the coastal lowlands—the area of easier communications—they have invariably arisen at the crossings of the lagoons and the backwaters.

14. The Tambaraparni basin.

S. MUTHUKRISHNAN, Madras.

This paper is an attempt at showing how the Tambaraparni basin adds a splash of green to the naturally dull brown colour of the vegetation map of Tinnevelly district, and to contrast the effect on environment in the basin with that outside.

The annual rainfall in Tinnevelly district is the lowest of all those of the east coast districts, and the effect of this on the geography of the district is one of difficult irrigation and poor produce. But thanks to the salutary effect of the summer monsoon coming through the Ariankavu Pass, and the effect of the monsoon winds giving rain just on the lee-side of the Ghats, this ribbon of the Tambaraparni is made possible in an area which would otherwise be scrub-jungle.

This river basin is in all ways different from the rest of the district. Here water is conserved systematically, and irrigation is used to the best advantage. The fertility of the basin and its three crops in a year contrast with the cotton crop of the north, and the palmyras and single crop of the south. The greatest number of the bigger towns in the district are in this basin, barring only a few outside it, which have grown due to commercial or nodal importance.

The individuality of this interesting region has been brought out in the paper.

15. The technique of regional geography.

A. G. OGILVIE, Edinburgh.

The lack of detailed regional studies in India and the advantages that would accrue from them are pointed out. The large body of information available for such synthetic studies is indicated, its character examined, and its proper use by geographers suggested. The more serious deficiencies in knowledge are discussed, first in regard to various aspects of the physical environment, and secondly in respect of the population, its distribution and its activities. In each category new field observations and new map compilations are required, demanding the use of methods so far scarcely applied to Indian regions. Special attention is directed to the possibility of constructing adequate maps of population density. The employment of diagrams of types hitherto little used is recommended. Means are suggested for establishing and maintaining contacts between geographers in Europe and India.

16. Settlements in the lower Indus basin (Sind).

MANECK B. PITHAWALLA, Karachi.

The lower Indus basin (Sind) has afforded facilities for some of the earliest human settlements in India, although it is an unstable land, with an unstable population depending chiefly upon unstable water supply. It is a land also of changing river courses, changing lakes, changing coastline, an advancing delta, intensely weathering Tertiary rocks and accumulating sand. Even the sand-hills of the desert are changeful as the winds blow during the year. The region, again, is within the danger zone of Northern India and is unique in its numerous hot springs. There is a possibility of changing climate as well and of gradually rising level and desiccation.

An antechamber for the whole country, with such a classical river as the Indus, Sind has not a single classical town left, except Sehvan (Sindomana), and that too in a partially decaying state. Floods were the greatest menace to human habitations, Mohenjo Daro itself being thrice abandoned on this account. Again and again people tried to resettle on mounds higher up, the river left its channels, and a whole river—the Hakra—dried up in the Pat-Thar section. Thus towns and villages often vanished.

The paper has been based on a detailed study of

I. *Geomorphology:* (*a*) Aggradation by the river and æolean agencies; (*b*) Erosion by external agencies; (*c*) Flood menaces; (*d*) Tectonic changes; (*e*) Growth of the delta.
II. *Hydrographical changes:* (*a*) Unstable water supply and water table; (*b*) Unstable drainage, river piracy, etc.; (*c*) Unstable lakes.
III. *Other changes* in human settlements due to political causes, etc.

Thus some 20 old sites have been located by the author in a map of Sind and their history given. The Sukkur Barrage with its perennial water supply and its final redistribution of population may mean more or less stable settlements in days to come.

17. Main house types in South India.

K. M. SUBRAMANIAM, Madras.

An attempt is made here to bring out the influence of environment in the choice of materials and the plan of construction of typical houses in the four main regions of South India.

The Ceded Districts type of stone-walled, flat-roofed houses, without a central courtyard, has developed in a region of scanty rainfall and extreme temperatures. The paucity of clay sutable for making bricks and tiles and the abundance of Cuddapah slabs explain the free use of the latter in various ways.

The Malabar house, built on high ground with steep gables, storage loft and a liberal use of wood, shows the adaptation to environment in a region of heavy rainfall and abundant forests.

In the Northern Circars are to be seen mud-and-brick houses with tiled or thatched roofs. Of the two types prevalent here, one has an open courtyard. Jungle wood and bamboo are largely used. The gable denotes a region of fair rainfall.

In the Tamilnad, the typical house has a central courtyard for free ventilation and sunshine, and a gently sloping gable, which show the influences of moderate rainfall and a fairly equable climate. The large use of bricks and tiles indicates the availability of suitable earth.

A closer study reveals minor local variations of the four main types.

18. Some aspects of the growth of greater Madras.

N. SUBRAHMANYAM, Madras.

The suburbs of Madras have grown ribbon-like along roads and railways by the overflow of the city population into the pre-existing villages along those routes. This development has taken place more fully in the south-west than in other directions, due to a higher and better-drained surface.

Besides the residential areas, large institutions—educational, recreational and governmental—have been established in this south-western part of Greater Madras, as space is limited and site values high within the city.

While shops and markets have grown up in the several suburban areas, the city in its turn gets its supply, especially of perishable articles, from the former areas and the surrounding rural parts.

Quick and cheap transport in the shape of suburban trains and buses ply frequently, making suburban life possible. Their number and frequency reflect the relative importance and popularity of the several suburban areas.

Recently, the vacant areas in the south-western parts of the city are being built over, due to a desire to enjoy the better conveniences and amenities of civic life ; and Thyagarajanagar, one of such recent extensions within the city, stands unique as the result of deliberate planning.

A plea is put in for the creation of a local authority to plan and co-ordinate the development of the several suburban areas without mutual competition, taking a long view.

19. The rivers of the Palar basin.

B. M. THIRUNARANAN, Madras.

The Palar is one of the three largest rivers of the Tamil region, and drains an area second only to the Cauveri. The lower portion of its valley is drained by several small rivers which enter the sea by separate mouths, even though they have very little flow of water. These small rivers have valleys too wide and large for their present volume of flow.

Bruce Foote has pointed out, in connection with the distribution of alluvium in this area, that several changes have taken place in the courses of these rivers, including the Palar, and that they have probably occurred in historic times. The Kalingattupparani, written by Jayamkondan, states that the Palar flowed to the north of Cojeevaram at that time (1070 to 1119 A.D.) and thus helps us to fix the date of the change in the course of the Palar. Bruce Foote has further suggested that these changes may have been caused by human agency. The serious floods which occur in the Palar as a result of the breaching of tanks along its course appear to be sufficient to have caused these changes in the past.

20. The geographical limits of the Tamil region.

B. M. Thirunaranan, Madras.

This paper attempts to define as precisely as possible with the aid of available topographic maps the geographical limits of the Tamil region, which forms a fairly well-defined natural unit. Its boundaries have been defined with reference to its physiographic characteristics, its geological structure and its plant cover, and the interrelationships between them. The limits thus determined differ from the limits indicated by climatic conditions, but show close agreement with the distribution of cultivation, of habitations, and of communications, as well as with the limits of the cultural unit, as shown by the distribution of the Tamil language and the traditional limits ascribed to the Tamil region.

21. The geography of disease.

(Miss) M. W. F. Waddington, Madras.

As Geography is the study of man in his environment, it is necessary to study the abnormal as well as the normal condition of man as a physical being. Of the factors of environment, climate is the chief in this connection. Its action may be direct, as when the conditions of air temperature, moisture and movement affect favourably or otherwise man's body: or indirect, as in the influence of climate on the crops, and other sources of food supply, and on insect life, which play such an important part in the study of disease. Effect chiefly seen in study of Tropical Medicine, but factors equally important in other climatic areas. Firstly, diseases due to heat or extreme cold; secondly, those showing the effect of altitude, and light; thirdly, those due to disturbances of diet; fourthly, the control of disease by water supply. Then comes the group of diseases of 'animal origin', parasites, flies, etc., or those contracted directly. The effect of modern developments of transport on distribution of disease. Study of important tropical and other diseases; their control, and their effect, apart from mortality. The universality of certain diseases. The economic importance of disease necessitates its inclusion in the study of Geography.

SECTION OF BOTANY

President:—B. Sahni, Sc.D., F.R.S.

Cryptogams

(*Chairman* : Prof. M. O. P. Iyengar.)

1. The nature of the subterranean algal soil-flora.

F. E. Fritsch, London.

Many diverse algæ can be obtained from soil-samples taken at considerable depths below the surface and there are records of the occurrence of algæ down to a metre or more. In Europe this subterranean flora practically always includes common surface forms, like species of *Hormidium* and *Chlorococcum*, although others like *Prasiola* and *Zygogonium* which do not readily fragment have never been recorded below the surface.

A number of soil-algæ can readily be grown in artificial cultures in the presence of carbohydrates (glucose, etc.) and other organic media. In many instances, too, it has been found that good growth is made, even in darkness. It has, therefore, been assumed that the algæ buried in the soil lead a saprophytic existence and there exhibit active growth and multiplication. It is very doubtful, however, whether this assumption is warranted. The organic materials present in the soil are certainly in great part different from those utilized in artificial cultures. Moreover, direct attempts to grow soil-algæ in sterilized soil in darkness (Petersen), have afforded no evidence that they can multiply under the circumstances.

We are indebted to Bristol for a statistical study of the numbers of algæ occurring at different depths in a soil, and this investigation showed that, whilst there was decrease in numbers immediately below the surface, there was marked increase at 4 inches. That minute particles like algal cells are readily washed downwards into the soil to considerable depths has been shown experimentally, and the abundance at the 4 in. depth is probably to be ascribed to the occurrence of some physical barrier.

The evidence indicates that the subterranean flora comprises forms which are passively washed downwards from the surface during rain; this is indicated by the almost invariable occurrence of common surface-forms in the deeper layers. The apparently distinctive subterranean types have, however, to be accounted for. Most of the work on soil-algæ in recent years has centred round their depth-distribution and little has been done on the surface-flora. The investigations of Petersen in Iceland and elsewhere have shown, however, that a far greater diversity of forms are to be found at the surface than has hitherto been supposed, and more extensive investigations would probably appreciably increase the number. Many of the distinctive subterranean forms that have not hitherto been found elsewhere belong to the Xanthophyceæ (Heterokontæ) and, since these forms are known often to be light-shy, it is quite probable that they do not inhabit the actual surface, but occur a short distance beneath it where light, though of lower intensity, still penetrates. It is not unlikely that investigation of the soil-layers that still receive light would demonstrate a microstratification of the algal flora and that the apparently distinctive subterranean forms would be found as inhabitants of the layers just beneath the surface.

It will be familiar that the ordinary means of dispersal of freshwater algæ from place to place is effected by wind-borne resting spores. Large numbers of these must fail to reach other bodies of water and will fall on the soil-surface, there either to perish or to be washed downwards by rain. This, in my opinion, accounts adequately for the very diverse casual element in the subterranean flora.

It is, therefore, probable that the true algal flora of the soil is to be found in the surface layers reached by light, and that it is here that it fulfills its important biological rôle. When once washed into the part of the soil that is in darkness, some individuals may persist as spores or perhaps even as vegetative cells, but it is improbable that these exhibit any vegetative activity there. From the economic point of view, the importance of algæ in the soil rests on their presence at the surface and it is here that their distribution and conditions of existence should be studied.

2. The life-cycle of the Ectocarpales.

F. E. FRITSCH, London.

It is now clearly established that the normal life-cycle in *Ectocarpus* and its immediate allies involves an isomorphic alternation between practically identical diploid and haploid phases, each capable of independent propagation by swarmers from plurilocular sporangia. In the more advanced members of the group Ectocarpales, taken in the widest sense, we find a marked elaboration of the plant-body which may attain to considerable complexity. Only in a few (e.g., *Nemoderma*, *Lithoderma*), however, does this elaboration appear to have affected both phases alike so that the alternation remains isomorphic. In the vast majority of the higher Ectocarpales it is the diploid sporophytic stage alone that has been elaborated, whilst the haploid phase remains a simple ectocarpoid filament, i.e. the life-cycle presents a heteromorphic alternation. It is very significant that the early stages of the diploid phase in these forms always appear as heterotrichous ectocarpoid plants, from whose erect branches the mature diploid phase is progressively elaborated. Under conditions of culture, and probably also at certain times of the year in nature, the juvenile diploid phases may persist for considerable periods (Sauvageau's ' plethysmothalli ' in part), propagating by means of diploid swarmers from plurilocular sporangia. At other times the gametophytic stages may remain asexual and propagate by means of haploid swarmers which represent apogamously developing gametes.

3. A note on two interesting South Indian marine algæ; *Pseudovalonia Forbesii* (Harv.) Iyengar comb. nov. and *Pseudobryopsis pambanensis* sp. nov.

M. O. P. IYENGAR, Madras.

Living material of both these algæ was brought from Pamban and grown at Madras in the laboratory and the several stages of their life-history were studied in some detail.

Pseudovalonia Forbesii (Harv.) Iyengar comb. nov.

(*Valonia Forbesii* Harv.)

This alga was until now placed in the genus *Valonia* but a study of its structure and development shows that it does not belong to this genus. A new genus *Pseudovalonia* is created for the alga. The reasons for separating it from *Valonia* are discussed in detail.

Numerous 4-ciliated motile spores are formed in the vesicle and escape through a number of round apertures formed in its wall and, after swarming for some time, finally settle down and grow into new plants. No case of sexual fusion was observed. The occurrence of 4-ciliated swarmers in this alga is interesting, since usually only biciliated swarmers are formed in the Valoniaceæ. The only previous record of 4-ciliated swarmers is by Kuckuck in *Valonia macrophysa* Kutz.

Under unfavourable conditions, plenty of cysts are formed inside the vesicle. These cysts grow into new plants, when conditions become more favourable again.

Pseudobryopsis pambanensis, sp. nov.

The structure of the thallus and the formation of the swarm-spores in a new species of *Pseudobryopsis* from Pamban are described in detail. When the spores are fully differentiated inside the sporangium, they are shot out in a mass through an apical rupture into the surrounding water and swim away as biciliated swarmers. No conjugation of these motile spores was observed nor their germination into new plants. This kind of sudden and forcible discharge of the contents of the sporangium shows a certain amount of resemblance to what takes place in the fungus, *Pilobolus*. Such a phenomenon does not appear to have been recorded in any alga so far.

The ruptured apex of the sporangium gets closed up by the formation of a new wall-piece. The same sporangium can, after a few days, again form a mass of spores at the apex as before and discharge them once more. This process may be repeated for each sporangium several times.

4. A note on a *Physocytium* from South India.

M. O. P. IYENGAR, Madras.

Physocytium confervicolum Borzi was first described by Borzi from Italy in the year 1883, but does not appear to have been recorded again by anybody so far. The author collected this alga two years ago in a stream at Vaiyampatti near Trichinopoly in South India. The structure and life-history of the South Indian form are described in detail and the author's observations confirm those of Borzi.

This genus was variously placed by the previous workers in different families. Lemmermann, West and Printz include it in the Chlorangieæ. Oltmanns places it in the Chlorodendraceæ. Fritsch has recently suggested its inclusion in the Chlamydomonadaceæ. The study of the life-history of the alga shows numerous points of resemblance to *Chlamydomonas* and the author therefore thinks that there is every reason for removing it from the Chlorangieæ and placing it in the Chlamydomonadaceæ as suggested by Fritsch.

The peculiar feature of the alga is the retention of the motile daughter-cells for a very long time inside the globular mucilaginous envelope formed by the gelatinization of the mother-cell-wall which again remains attached to the substratum by the two original elongated ciliary stalks. This motile stage of the daughter-individuals inside the mother-wall forms the dominant vegetative phase of the alga. It is interesting to note that this type of motile condition of ciliated daughter-individuals inside the gelatinous mother-envelope for a very long time as the dominant vegetative condition of the alga has been recorded in a few other Volvocaceæ also. A very brief account of these is given in the paper.

5. Aposporous prothalli in *Osmunda javanica* Bl.

P. C. SARBADHIKARI, Colombo.

1. Aposporous growth of the prothalli originates either from the surface, or more frequently from the edge of the frond.
2. The majority of the prothalli are regular in shape, but irregular ones are by no means uncommon.

3. The regular prothalli are much more heart-shaped, except that they have no well-developed cushion.

4. The appearance of the embryo is heralded by the formation of a very much localized hypertrophy situated just behind the growing-point.

5. The embryo arises as a direct vegetative outgrowth from the prothallus, and, when very young, consists of a mass of cells in which the apical cells of the cotyledon, stem and root, are recognizable.

6. There is no reduction of the chromosomes on passing from the sporophyte to the gametophyte.

7. The evidence afforded by the material on which the study of these prothalli has been based leads to the conclusion that the whole process is to be regarded as a kind of irregular fertilization. The doubling of the chromosomes receives an explanation strictly analogous to that afforded by the normal fusion of the oosphere and spermatozoid. But instead of one cell only serving as the starting point for the new generation, a number of such units loosely co-operate to produce it.

6. Contributions to our knowledge of Indian marine algæ. I. On some green algæ from Karachi.

P. ANAND, Lahore.

The total number of species described so far is 18, some of which are new records for the Indian coast. They include 3 new species (*Cladophora kemariensis, C. Fritschi, Chaetomorpha prostrata*) and one new variety (*Caulerpa racemosa* var. *intermediata*).

Cladophora kemariensis: Plants forming loose tufts, 12–35 cm. high, without any branches in the basal portion, dark olive-green, flaccid, cells of the main filaments 220–270μ in diameter, more than 10 diameters long, branching alternate or opposite, in certain terminal tufts di-polychotomous, ultimate ramuli alternate, with or without one or more cells in between the ramuli and strongly lamellate cell walls, cells of the ramuli 100–150μ in diameter, 2–4 times as long.

C. Fritschi: Plants 9–15 cm. high, yellow-green in colour, soft, tufts of ramuli in which the branching is di-polychotomous, cells of the main filaments 200–250μ in diameter, 6–8 times as long, cells of the ramuli 50–80μ in diameter, 4-5 times as long.

Chaetomorpha prostrata: Plants forming compact mat by intertwining of the filaments. Filaments declined, coiled and contorted, attached by means of rhizoids to the soil and to one another. Rhizoids usually one, rarely two from each cell, binding lot of mud.

Caulerpa racemosa var. *intermediata*: This variety combines the characters of a number of different forms. The same assimilator may bear ramuli with convex, concave or disc shaped apices and on the same stolon some assimilators may bear uniformly thickened ramuli. Some assimilators may also bear a few typical peltate ramuli like those of *C. peltata*.

7. Observations on the morphology, cytology, and development of a South Indian Pithophora.

K. R. RAMANATHAN, Madras.

1. Three forms of *Pithophora* (probably belonging to *P. polymorpha* Wittr.) were investigated in detail with a view to study their structure and life-history. All the three forms showed a differentiation into a distinct cauloidal and a rhizoidal system. Helicoids were observed frequently in all the three forms and showed several variations. In addition to the usual unseptate helicoids described by various authors, septate helicoids were also often observed. Such septate helicoids do not appear to have been recorded so far in *Pithophora*. These helicoids, whether

septate or unseptate, were often observed to proliferate new filaments from some of their branched ends. Proliferations from helicoids have not been previously known in *Pithophora*.

2. A cytological study of the vegetative cell and of the resting spore was made with the help of microtome preparations. The nuclear division is mitotic and quite similar to that of *Cladophora*. The number of chromosomes is probably 30–36. The spindle is intranuclear. The nucleolus reacts negatively to Feulgen's nuclear reaction. In addition to normal nuclei, some abnormal nuclei nearly twice the size of the ordinary ones were observed. The evidence available suggests that these large nuclei are probably derived by the fusion of two ordinary nuclei. Such large nuclei were found inside the spores also.

3. The development of the spore was followed in detail. The release of the ripe spores does not take place by the mere decay of the thallus, as is usually believed. The subsporal cells form a ring-like swelling on either side of the ripe spore through the activity of their sparse protoplasmic contents. Soon a break of the filament takes place along the circumference of each of these two ring-like swellings and liberates the spore from the filament.

4. The germination of the spore was followed in detail and some new observations are recorded.

8. The prothallus of *Equisetum debile*, Roxb., var. *pashan*, Poona.

T. S. Mahabale, Ahmedabad.

The prothallus of this local variety of *Equisetum* is a small, circular, button-shaped body, red, brown or green in colour, measuring about 1 to 2·5 cms. in diameter and, 0·2 to 0·3 cm. in height, including the lobes.

The body of the prothallus is divisible into three parts: (1) an upper part, bearing erect leafy lobes, marginal meristem and reproductive organs; (2) a massive cushion in the middle, made up of four to seven layers of thin walled cells; and (3) a lower part with numerous rhizoids. The prothalli are monoecious, and agree in this respect with the prothalli of *E. lœvigatum*, *E. kansanum*, and *E. debile* proper, but not with those described by Buchtien, Goebel, Hofmeister, and Phatak.

The paper further discusses the symmetry of the prothallus in *Equisetum*. The prothallus is radially built in Psilotales and Lycopodiales. The gametophyte of *Equisetum*, as found in nature, has erect lobes, reproductive organs and embryos all round the thallus, and a cushion in the middle. It is difficult to consider such a structure as dorsiventral. A comparison has been further made with the prothallus of *Lycopodium cernuum* and it has been suggested that flattening out of the prothallus in *Equisetum* is due to condensation of the middle region corresponding to the shaft in *L. cernuum*. This, however, does not appear to affect its symmetry which may, therefore, be considered as radial.

Phanerogams and Taxonomy

(*Chairman*: Prof. S. P. Agharkar.)

9. The origin of different forms of ovules in the angiosperms.

A. C. Joshi, Benares.

Evidence is presented from the development of the carpels and ovules in a number of families of modern flowering plants and from the systematic distribution of the orthotropous ovules to show that the different forms of the ovules have originated as a result of various mechanical forces exerted on the ovules during development. The subjection of an ovule to pressure from all sides during its development has resulted in the origin of the anatropous ovule. Absence of pressure from one side has resulted in the appearance of the amphitropous ovules. The campylotropous ovules have originated either from the anatropous or amphitropous ovules, because they pass through these stages during their development and the ovules in some cases are ana- or amphi-campylotropous. They represent the most advanced form of the ovule, and the factors responsible for their origin from anatropous or amphitropous ovules are either extra external pressure exerted by the growth of the placenta and funicle or internal pressure caused by the stretching and curving of the embryo-sac. Such a view of origin of the different forms of ovules explains the occurrence of transitional forms in many plants, the variations in the orientation of the ovules in a carpel or in the carpels of closely related species and genera, and the absence in many cases of any relation between the direction of the ovules and the position of the style and stigma. The anatropous ovule is most common now because with the porogamous method of fertilization it is the most suitable form of the ovule. It limits to the minimum the distance through which the pollen-tube has to travel in an empty space.

10. Observations on the flora of Bhutan.

K. P. BISWAS, Calcutta.

The territory of Bhutan forms an integral part of the botanical province known as the Eastern Himalayan Province. In discussing the vegetation of Bhutan one cannot separate the adjacent plant communities of Sikkim on the west and the vegetation of the montane zone of Assam. Plant hunting in the Sikkim area dates from a very early period, and systematic collection of the interesting flora of this region was started by J. D. Hooker in 1848. Hooker's account and his treatment of the plant communities will supply valuable data upon which any conclusion on the vegetation of this part of the country can be based. Although much of the primeval nature of the forest flora and political demarcation of territories have undergone changes since.

The present boundary of Bhutan does not include Kalimpong, which was annexed after the detention of Hooker in 1849. Since 1866 onward this portion of Bhutan has formed part of the Darjeeling District. A fair proportion of the 'Bhutan' collections of Hooker, Griffith and Thomson are from the Kalimpong area. Apart from the earlier scrappy collections of Bhutan, Mr. R. E. Cooper, Curator of the Royal Botanic Garden, Edinburgh, made a substantial collection in Bhutan in 1914. The war prevented the working out of this collection for some time, and the collection was partly destroyed during the war and much of the material is in a dilapidated state, although a substantial portion of the collection, particularly primulas, has been worked out. The writer has also been able to add to his list a few hundred of these plants with the help of Sir William Wright Smith and Mr. Cooper. I have also had the opportunity to collect along the borders of Bhutan and Northern Bengal. His Excellency Sir John Anderson, with Babu H. P. Nasker, one of the Assistants of the Royal Botanic Garden, Calcutta, made a valuable collection from Bhutan proper. But the most important collection which will form the bulk of the Bhutan flora of late, apart from those of older collections, is that of Messrs. Ludlow and Sherriff. They have been accumulating a rich harvest of specimens from many of the hitherto unknown localities of Bhutan since 1933. Some of their plants have therefore turned out to be new. They have also collected seeds and these are under cultivation at the Royal Botanic Garden, Edinburgh and Royal Botanic Gardens, Kew. I have been able to incorporate the list of the species collected by Messrs. Ludlow and Sherriff by kind permission of Mr. Ramsbottom, Keeper of the British Museum (Natural History), London.

Taking into consideration this fairly substantial material, the plant succession from the subtropical zone to the snow line is in general agreement with the flora of this region as a whole, although, as shown on the table, differing in the composition of the species. I also agree with Captain Kingdon Ward that the density of Rhododendron association is reduced in the extreme north-eastern flanks backing Upper Burma and Szechuan. It is indicated even on the right flanks of Bhutan hill ranges. Comparison, as illustrated in the photographs of the Sikkim and Bhutan areas, indicates such a difference in the nature of the vegetation as one proceeds from Sikkim to Bhutan.

11. The Monocotyledonous seedlings of certain Dicotyledons with special reference to the Gesneraceæ.

ARTHUR W. HILL, Kew.

The paper opens with a discussion of certain Dicotyledonous genera whose seedlings normally possess only a single cotyledon instead of the pair typical for Dicotyledons. These include *Cyclamen, Ranunculus Ficaria, Bunium, Erigenia, Corydalis cava, Pinguicula* and *Abronia.* In all these cases there appears to be no support for Miss Sargant's theory that the single cotyledon represents two fused cotyledons. Evidence is produced to show that the second cotyledon may either be rudimentary and capable of development (*Cyclamen*) or wholly suppressed (*Ranunculus Ficaria, Bunium,* etc.). Reference is also made to the apparently monocotyledonous seedlings of the bulbous Peperomias, where one of the two cotyledons never leaves the seed-coat and is a purely absorbent organ.

The various genera of Gesneraceæ, in which one of the two cotyledons of the seedling is arrested in development and ceases to grow, are then considered. These include the Asiatic genera *Chirita, Moultonia, Monophyllea, Didissandra,* and *Didymocarpus* from Indo-Malaya, China, Australia and Tropical Africa: *Streptocarpus* from South Africa and Malaya: *Klugia* from Ceylon and America, and several others. Some of these, such as many species of *Streptocarpus* and a few Chiritas, *Moultonia, Monophyllea, Acanthonema,* etc. possess only one leaf—the enlarged cotyledon—throughout their life-history. Other species of *Streptocarpus* and *Chirita* and also *Saintpaulia* (E. Africa), *Ramondia* (Europe) and others develop a rosette of leaves but no plumular axis, while the third group including most Chiritas, several species of *Streptocarpus, Briggsia* and *Klugia* and some other genera, consists of herbaceous plants with well-developed leafy shoots. In all these cases one of the two cotyledons ceases to grow at an early stage and aborts and, in the case of the caulescent species, no functional axillary bud is developed in its axil.

It is considered that the unifoliate genera and species represent the primitive conditions and that the caulescent forms are derivates from ancestors which had assumed the unifoliate habit, and have been unable, except in rare cases, to recover the use of the second cotyledon whose development has been arrested.

It is further demonstrated that the single leaf of the unifoliate genera and species described is not really the enlarged cotyledon, since the cotyledon itself can be recognized as a persistent tip in many cases on the large, hairy lamina which is the sole leaf of the plant. The 'leaf' arises as the result of meristemmatic activity at the base of the petiole, in the region where the persistent cotyledon joins the hypocotyl. As a result of this meristematic activity the large lamina of the *Streptocarpus* leaf, reaching to as much as 30 inches long by 22 inches wide in *S. Dunnii*, or the large 'cotyledonary leaves' with long petioles in *Chirita lavandulacea*, etc. are formed.

12. The principles of floral construction.

E. R. Saunders, Cambridge.

It is a familiar fact, though often ignored, that the traditional interpretation of the construction of many floral types rests upon suppositions unsupported by any evidence. These suppositions almost invariably take account only of external appearances. When observation is extended to the internal structure—to the vascular system—many prove to be 'morphological fictions' and, moreover, to be entirely superfluous.

It becomes clear from a study of the vascular system that the vascular ground-plan is directly related to the floral ground-plan and exhibits a similar degree of constancy. The nature of this relationship shows that it is no longer necessary to postulate, as hitherto, hypothetical splittings and fusions, 'false' partitions and vanished whorls. The new evidence solves the problem presented by the superposition of successive whorls (one class of case excepted). It leads to a wholly new conception of the construction of the syncarpous gynaeceum. It destroys the fiction of the commissural stigma and the epigynous flower. It throws an entirely fresh light on parietal, axile, basal and free-central placentation; on the gynobasic style; on septicidal dehiscence; and on various other morphological features hitherto unexplained. Among such are the number of styles and stigmas in Ureneæ (Malvaceæ), *Eschscholtzia* (Papaveraceæ), *Aphyllanthes* (Liliaceæ), *Pœpalanthus* (Eriocaulaceæ), and of the partitions in the ovary of *Linum*; the position of the solitary ovule in *Astrocarpus* (Resedaceæ); the dehiscence of the fruit in *Epimedium* (Berberidaceæ); the nature of the difference in the ground-plan of the gynæceum in *Reseda luteola* and *R. odorata*; the fact that in some isomerous types the suppression of a whorl does not affect the position of the succeeding whorl; the fact that obdiplostemony does not occur among Monocotyledons; and other features and interrelations in many families.

13. The embryo sac and embryo of *Tamarix chinensis* Lour.

V. Puri, Meerut.

While at Kiel (Germany) Dr P. Maheshwari of Agra collected some material of *Tamarix chinensis* in September 1936 and very kindly passed it on to the author for investigation. The flowers are hermaphrodite but the development of the male gametophyte goes much ahead of the female gametophyte. Usually a single hypodermal archesporial cell becomes differentiated in a narrow bi-tegumentary nucellus. By cutting off a parietal cell it functions as a megaspore mother cell. The nucleus divides twice to produce four megaspore nuclei which do not become separated by walls. The most common arrangement for these nuclei is 1+2+1. Later on the two central nuclei descend into the chalazal end giving rise to a 1+3 arrangement. At the next division the three spindles in the chalazal region fuse together and result in only two nuclei which are larger in size than the micropylar ones and contain 3n chromosomes. Again a four-nucleate embryo sac is produced. The next division results in a normal 8-nucleate embryo sac. The development of the embryo sac is thus after the '*Fritillaria*-type'.

The fertilized egg soon divides by a transverse septum. Some more transverse divisions take place to form a linear row of 6 or 7 cells. Then the apical region swells up to form a bulbous embryo proper while the basal portion forms a spindle-shaped suspensor. Further development results in a typical dicotyledonous embryo.

14. A contribution to the knowledge of the wood-anatomy of a few Meliaceæ and Rutaceæ occurring in Bengal.

S. HEDAYETULLAH *and* A. K. CHAKRAVORTY, Dacca.

The value of the study of wood anatomy from the systematic point of view has been emphasized.

The importance of statistics in the study of wood-anatomy has been discussed.

Twelve available species of meliaceæ belonging to ten genera and two species of rutaceæ belonging to two genera have been worked out.

Jeffrey's and Schulz's methods have been found suitable for maceration and the cellulose acetate method described by Williamson for softening.

The classification proposed by Kribs on the basis of wood anatomy has been reviewed and the position of *Carapa* and *Cedrela* in the Swietenioideæ has been discussed.

The separation of *Chloroxylon* from the meliaceæ on the basis of wood structure has been confirmed.

Other genera have also been discussed. They confirm mainly the observations of Kribs, with minor differences which are recorded.

15. A contribution to the morphology of *Carthamus tinctorius*, Linn.

I. BANERJI, Calcutta.

1. The development of the floral parts takes place in the following order :—petals, stamens, sepals and carpels.

2. The development of the microspores appears to be normal and no irregularity has been noted. The meiotic divisions are of the simultaneous type. The haploid number of chromosomes is twelve. A periplasmodium is formed in the anther. The plasmodial substance is deposited on the spiny exine of the pollen grains which then become differentiated as blunt processes. The microspores, before liberation from the microsporangium are uninucleate and have three germ pores.

3. The ovule is anatropous and possesses a single integument and scanty nucellus. During the development of the embryo-sac the single layer of cells enveloping it disintegrates completely and the embryo-sac is enclosed by the integument whose innermost layer becomes differentiated and forms an ' integumental jacket '.

4. A single archesporial cell differentiates in the hypodermal layer of the nucellus and functions as the megaspore mother cell. Two megaspore mother cells have also been observed lying side by side in the hypodermal layer. As a result of the activity of the megaspore mother cell a linear tetrad of megaspores is produced of which the chalazal one gives rise to an eight-nucleate embryo-sac by three successive divisions.

5. The mature embryo-sac is of the normal angiospermous type. The nuclei of the antipodal cells divide and the cells become multinucleate.

6. The synergids and the antipodals degenerate before fertilization and the secondary nucleus lies very close to the egg. Fertilization is porogamous. The sperms appear as distinct nuclei.

7. The division of the endosperm nucleus occurs prior to that of the egg and the endosperm is of the nuclear type. The zygote divides first by a transverse wall. The further development of the embryo appears to be of the *Capsella* type.

16. On the floristic elements of the flora of Bengal, Bihar and Orissa and their origin.

A. K. GHOSH, Calcutta.

In this paper are summarized the results of a study of the distribution of about 1,200 species of trees, shrubs, undershrubs and perennial herbs, occurring within the boundaries of Bengal, Bihar and Orissa excluding the Himalayas.

This area is divided into the following 8 sub-areas, based mainly on the climatic factors, viz., temperature, rainfall and relative humidity.

I. *Coastal Orissa.*
II. *Orissa proper.*
III. *Chotanagpur.*
IV. *Sundribans.*
V. *E. Bengal.*
VI. *Chittagong.*
VII. *Bihar.*
VIII. *W. Bengal and C. Bengal.*

Floristically areas II and III form part of the Deccan province areas I, IV, VII and VIII form the province of the Lower Gangetic Plain, and the areas V and VI are included within the N.-W. Burman province.

An attempt has been made to indicate the source from which these species have entered the area investigated by a study of their means of dispersal and their total distribution.

The routes by which migration of the species has taken place are shown on a map which will be exhibited. The various elements composing the flora are as follows :—

1. The *Bengal element* or the element represented by the Lower Gangetic Plain.
2. The *Malabar element.* A large number of endemic species have been produced in this area and have thence entered Bengal.
3. The *Upper Burmese element,* representing the sub-tropical rain forest element of Assam and N. Burma.
4. The *Afro-Arabian element* which entered the Indian area from the west.
5. The *Chinese element,* hardly extending beyond the Himalayas.
6. The *Himalayan element*; this has also produced endemic species.
7. The *Malayan element,* many species of which are dispersed by the sea and are carried to the Gangetic delta (Sundribans) and thence carried further inwards.
8. The *Burmese element* which has produced a large number of endemic species within the area.
9. The *Oriental element* migrating from the Mediterranean through N.-W. India.

17. A contribution to the life-history and cytology of some Panjab Zygophyllaceæ.

S. L. GHOSE *and* DILAWAR HUSSAIN, Lahore.

1. Observations on the micro- and mega-sporogenesis of *Tribulus terrestris* and *Peganum Harmala* are recorded.
2. No periplasmodium was seen to be formed.
3. The second contraction of the spireme has been observed in heterotypic division.
4. In *T. terrestris* sometimes all microspores of a tetrad may disintegrate.
5. In *P. Harmala* cytokinesis takes place by furrowing.
6. The generative cell is lens-shaped.
7. In *P. Harmala* the megasporangial archesporium is many celled, but only one of the cells is functional.
8. In both plants a primary wall cell is cut off in megasporogenesis.
9. The synergids are hooked and the three antipodals lie in one row.

Genetics and Cytology

(*Chairman* : DR. E. K. JANAKI AMMAL.)

18. The biology of crossing-over.

C. D. DARLINGTON, London.

Two important changes take place at meiosis : reduction in the number of chromosomes by the segregation of partners and crossing-over between those partners. Crossing-over takes place as a result of a torsion developed in the paired chromosome threads. This torsion twists the threads round one another until an equilibrium is reached like that reached in the operation of spinning. The chromosomes divide, the equilibrium is upset and the daughter threads break at opposite points ; the broken ends twist and rejoin : crossing-over has taken place.

Since attraction is limited to pairs of threads, division of each chromosome into a pair of threads causes the partners to fall apart. But since crossing-over takes place at the same time and produces an exchange of partner amongst the threads, all four threads remain held together at the points of exchange or chiasmata. All the later association of the chromosomes and hence their segregation and reduction depends on these chiasmata.

Crossing-over is not therefore merely a genetical incident in the segregation of chromosomes at meiosis. It is the mechanical *conditio sine qua non* of meiosis and hence of sexual reproduction. From this fundamental effect of crossing-over we must distinguish its incidental effects. These are of two kinds. First it simply recombines the parts of the chromosomes, or genes, without changing their arrangements. Secondly in structural and numerical hybrids it has the special effect of altering the arrangement of the genes and producing in the already changed chromosomes secondary changes. Such changes are responsible for the attachment of X and Y chromosomes in *Drosophila*, the production of several kinds of mutants in the hybrid species of *Oenothera* and the fragmentation of chromosomes in many known interspecific hybrids.

We do not yet know how important secondary structural change may be, but it is probably an integral part of the mechanism of variation in all sexually reproducing organisms. The incidental effect of crossing-over has thus become as important as the fundamental and original one.

19. Structure of the meiotic chromosomes of *Hosta Sieboldiana* Hosk.

H. K. NANDI, Calcutta.

A detailed investigation of the present material furnishes evidence to show that the chromosomes exist as spiral threads in all the stages of chromosome cycle.

At the heterotypic prophase the 'chromomeric' appearance of the leptotene and zygotene threads are seen as optical images produced by twists of the finely coiled spiral structure of the lower order.

At diplotene each homologue shows indication of doubleness resulting in quadripartite structure. It can now also be seen that the chromatids have exchanged partners thus forming chiasmata.

At diakinesis each chromatid is seen as a doubly coiled structure composed of major and minor spirals which are fitted into the spiral of its partner.

The bivalent chromosomes at metaphase are shorter and thicker. This shortening is due to the development of the major spiralling or spiralling of higher order. The double coiled nature of each chromatid is clearly demonstrable by ammonia treatment.

As the chromosomes reach the poles at anaphase I, they become drawn out when the tension of the major spiral is released. The sister chromatids become separated except at the spindle-attachment region.

At telophase the major spirals still expand due to the relaxation of the coils and also because the matrix of the chromosomes is exuded out to contribute to the formation of the nucleolus. The minor spiral or spiral of the lower order is now clearly visible.

The chromosomes in the homotypic metaphase show spiral structure in which the gyres are of smaller diameter and larger in number than those of the spirals of the heterotypic metaphase chromosomes, i.e. spirals of the higher order.

Convincing evidence of the presence of coiled chromonema throughout all the phases of chromosome history substantiates the theory that the individuality and continuity of the chromosomes is maintained from one cell generation to another and suggest that spiralization is a mechanism essential for the preservation of the linear order of the genes.

20. Cytogenetical studies on jute.

H. K. NANDI, Calcutta.

The diploid chromosome number of *Corchorus capsularis* Willd., is $2n = 14$. No other deviating number with less or more chromosomes has been reported in the species or varieties of jute.

The writer in the course of his cytogenetical studies discovered a variant plant in the jute cultures which is characterized by much smaller and deeply serrated leaves quite different from the normal varieties. The plant is bushy in nature and profusely branched. The two hood-like appendages generally present at the base of the lamina in the normal varieties are totally absent in the variant. Flower buds are much smaller, stamens fewer in number ranging from 10–16, the normal with 15–24. Some of the stamens in the mutant are transformed into petals. Anthers are generally empty with deformed and aborted pollen grains. Ovary with a very short style and trifid or 4-fid stigmas, the normal with a long style and undivided stigma. Capsule smaller with very few seeds.

Cytological studies have revealed 15 chromosomes in the root-tip cells. This is further corroborated by studies of the pollen mother cells. The variant is therefore a trisomic mutation ($2n+1$).

Study of the pollen mother cells at diakinesis revealed six pairs of bivalents and a trivalent as also seven pairs of bivalents and an univalent. At anaphase I and II, eight and seven chromosomes could be seen passing to the daughter cells. Sometimes a lagging univalent was noticed in the first and second division.

The trisomic thus produces dimorphic gametes with 8 and 7 chromosomes. The breeding behaviour of the mutant shows that when the trisomic is selfed, it produces a high percentage of mutants in the F_1. When the trisomic is used as male and the normal as the female. the percentage of trisomic mutation is considerably reduced in the F_1 progeny. This shows that egg cells with one extra chromosome are more effective in fertilization and in the transmission of mutant characters.

Studies of the normal variety from which the mutant arose have shown failure of pairing of one bivalent in the pollen mother cells. This gives rise to gametes with 8 and 6 chromosomes. Similarly it is expected that such things happen in the megaspore division. The trisomic most probably arises from the union of an egg cell with 8-chromosome gamete and a 7-chromosome pollen.

Clear evidence of secondary association is observed for the first time in jute. The maximum association is two groups of two bivalents, the other three bivalents remaining separate. It is therefore suggested that the basic number of *C. capsularis* is $b = 5$, the present number $n = 7$, is secondarily balanced.

21. Chromosome behaviour in Saccharum spontaneum × Sorghum durra hybrids.

(MISS) E. K. JANAKI AMMAL, Coimbatore.

Twelve out of thirteen hybrids between *Saccharum spontaneum* ($2n = 56$) and *Sorghum durra* ($2n = 20$) had $2n = 38$ chromosomes, and a single 'triploid' hybrid plant (containing two sets of *S. spontaneum* chromosomes and one set of *Sorghum*) had $2n = 66$. The characteristic 'A' chromosomes with a prominent sub-terminal attachment constriction, which is found in the genus *Sorghum*, could be identified in all the plants examined. A comparative study of meiosis and an analysis of chromosome pairing in both types of hybrids is presented.

22. The structure of the chromosome.

R. RUGGLES GATES, London.

All the recent critical work has decided against the chromomere theory and in favour of the theory of a chromonema or thread of uniform thickness composing the essential part of the chromosome in plants. Animal cytologists still frequently adhere to the chromomere hypothesis, but it appears unlikely that such a fundamental difference in structure exists between plant and animal chromosomes.

Critical observations of plant and animal chromosomes indicate that the chromosome is always at least a two-stranded structure, each of the strands which is about to separate in metaphase undergoing a split in prometaphase. It is possible that the chromosome may even be four-stranded, as the work of certain investigators suggests. The individual threads are spirals throughout the mitotic cycle, reaching the maximum of condensation at metaphase and being drawn out so that they more or less completely lose their spirality in the resting stage. The spiral itself may be ultimately related to the structure of the protein molecule.

Recent work on the satellites in relation to the nucleolus represents one of the most important advances in our knowledge of nuclear structure. Studies of rice, wheat and various other plants show that the history of the satellites and their relation to the nucleoli can be used as an important method of confirming or altering conclusions drawn from secondary pairing. In this way secondary polyploids can be discovered and the phylogenetic history of the nucleus from genus to genus can be read in its structure. This method is destined to throw much light on intergeneric relationships where changes in chromosome number are involved. The nature of the thread attaching a satellite to its chromosome needs further study.

The salivary chromosomes of insect larvæ, with their enormous size and conspicuous pattern of chromatin discs apparently corresponding to genes, appeared to offer great hopes of further understanding of chromosome structure. But recent observations and conclusions have been so divergent and contradictory that this hope has not been fulfilled.

The numerous similarities in the structure of animal and plant chromosomes and their similar relationship to the nucleolus in the higher organisms, together with divergencies in such groups as the Protozoa and the Rhodophyceæ, indicate a great deal of parallel evolution in the nuclei of higher plants and animals.

Mycology and Plant Pathology

(*Chairman*: PROF. K. C. MEHTA.)

23. Host range and identity of the smut causing root-galls in the genus *Brassica*.

B. B. MUNDKUR, New Delhi.

Symptoms of a smut which produces root-galls in *Brassica campestris* L., are described and it is shown by pot experiments, that considerable reduction in yields may be caused as a result of attack by this fungus. The smut is soil-borne and the galls are capable of spreading the disease from place to place.

Besides mustard, several other species of *Brassica* including radish, turnip and cabbage are attacked by it.

This smut is not capable of infecting *Turritis glabra* and *Matthiola sinuata*, species that are susceptible to *Urocystis coralloides*. This fact, and the spore-measurements indicate that the Indian smut is not *U. coralloides* and that it is a new species. The name *Urocystis brassicæ* is therefore proposed for it.

24. On a new Ravenelia from India.

B. B. MUNDKUR *and* N. PRASAD, New Delhi.

A rust which belongs to the genus *Ravenelia* was found affecting *Acacia modesta* Wall., near the Imperial Agricultural Research Institute, New Delhi. Collections were made on January 6th and February 26th, 1937. Pycnial. aecial and uredial stages were not present. The telial heads borne on short, hyaline, deciduous stalks, measured 83–128μ in diameter; they are convex, hemispherical to orbicular, and alantoid in side-view. The teliospores are unicellular, 10–12 across, with epispore 5–7μ thick at apex. The cysts are pendent, oblong-ovate and their number is the same as the number of single cells in the head. *Ravenelia* belongs to the sub-section Haploravenelia and on comparison with other species reported to occur on the genus *Acacia*, this specimen has been found to be a new species. The name *Ravenelia Taslimii* Mundkur nov. sp., is proposed for it.

25. Effect of the locality and the time of sowing on the incidence of 'Spot blotch' disease of barley.

M. MITRA, New Delhi.

While studying the 'Spot blotch' disease of barley caused by *Helminthosporium sativum*, the author has observed: (1) that the incidence of the disease varies from year to year, (2) that in the same year the range of variation in infection in different plots was quite marked although the seed had been sown on the same date, (3) that within the same type which was sown on different dates in different plots, the percentage of leaf area destroyed by *H. sativum* varied from 1·37–7·83, which is indeed a wide range, (4) that within the same plot, the portion of land on which seed was sown earlier showed more disease. Environmental factors such as temperature, humidity, soil type, etc. play an important part in the development of 'Spot blotch' disease of barley.

26. Competition in fungi.

T. S. SADASIVAN, Lucknow.

A number of fungi, *Fusarium* sp., *Helminthosporium* sp., *Gibberella* sp., *Monilia* sp., *Phoma* sp., and *Dendryphiella* sp., were used in order to ascertain the nature of competition in fungi, by allowing them to compete in media differing in composition of acid, alkali and nutritive chemicals. Inocula were placed mixed, adjacent and 2 cm. apart. Interesting results were obtained with two fungi—a species of *Fusarium* and a species of *Dendryphiella*. Some of the more important points observed were :

1. In the standard synthetic medium both the strains had almost the same rate of growth making it possible for them to compete on more or less equal terms.
2. In all cases where the inocula were placed adjacently, the mutual reaction between the two fungi was more pronounced.
3. In the malic acid media *Dendryphiella* remained recessive in the adjacent cultures up to 1·0% and then was dominant till 1·75% when both the strains ceased growth.
4. In the NaOH media, in the adjacent cultures, *Fusariam* was recessive up to 0·25% (after fluctuating in the lower strengths) and dominated over *Dendryphiella* till 0·5% when the growth of both came to an end.
5. In the adjacent cultures in the Na_2CO_3 media, *Fusarium* was dominant throughout the series and *Dendryphiella* stopped growth completely at 0·15% (after fluctuating in the lower strengths) while *Fusarium* grew on unhampered.
6. In KNO_3 media, in the adjacent cultures, *Dendryphiella* dominated up to 0·75% and then *Fusarium* took the upper hand and finally overcame *Dendryphiella* by completely stopping *Dendryphiella* growth at 10·0%.
7. In the adjacent cultures in the Glucose series *Fusarium* was throughout dominant from 0·1 to 12·0% and *Dendryphiella* recessive with three points of complete inhibition at percentages 0·1, 0·2, and 0·4.
8. In all cases where the fungi have been inoculated adjacent and 2 cm. apart, the growth rate increased and complete inhibition took place at a higher percentage of the different acids, alkalis, etc. as compared with the controls.

I wish to express my grateful thanks to Dr. S. N. Das Gupta for suggesting this problem and offering me ready guidance and criticism throughout.

27. The sexual process in fungi.

A. H. R. Buller, Kew.

Physiology and Ecology

(*Chairman* : Prof. P. Parija.)

28. Studies on the effect of definite doses of alcohol on the activity of certain enzymes in the leaf of *Eugenia jambolana*.

U. N. Chatterji, Allahabad.

Experiments were carried out with a view to find out the effect of alcohol-injection on the activity of certain enzymes in the leaves of *Eugenia jambolana*. Definite doses of ethyl alcohol, CH_3CH_2OH, were injected, the percentages ranging from 2 to 15. The enzymes studied were diastase and catalase.

It was seen that alcohol-injection increased the activity of these enzymes, the highest stimulation obtained was by a 5% dose in the case of diastase and 8% dose in the case of catalase. The increase in the activity of diastase corresponds with increase in respiratory carbon dioxide output as enhanced by alcohol.

Beyond 5% and 8% alcohol-injection there is a progressive fall in the activity of these enzymes.

It has also been found that alcohol-injection reduces the hydrogen-ion concentration of the leaves or increases the pH. It seems that alcohol-injection shifts the pH to a value nearer the optimum for diastase and by reducing the medium from a more to a less acidic one increases the catalase activity. The acceleration of both the enzymes diminishes considerably after 24 hours.

29. The effect of carbon dioxide on water entry into the roots.

T. Ekambaram *and* V. K. Kamalam, Madras.

1. Absorption of water by the roots of Tomato and *Erythrina indica.* in water with CO_2 dissolved in different concentrations was studied.
2. In Tomato, there was an initial fall, a subsequent rise and a final fall in the rate of absorption with high concentrations. There was no effect with lower concentrations. In *Erythrina*, water saturated with CO_2 caused depression but no effect was observed with high concentrations as in Tomato. But depression occurred when kept in higher concentrations for longer periods. With lower concentrations there was no effect.
3. That no oxygen was supplied in the solution is emphasized.

30. Permeability of the xylem vessel wall.

T. Ekambaram *and* V. K. Kamalam, Madras.

1. Cut ends of the shoots of *Tecoma Stans* were placed in 10% solutions of 24 different chemicals.
2. As the solution ascended into the shoot, two types of killing of the living cells in the stem and leaves were observed: (1) the acetic acid type in which the cells adjoining the xylem vessels in the stem and the cells along the veins in the leaves were first killed, and (2) the Potassium Nitrate type in which the cells in the stem along the vessels were not killed but the killing started in the groups of mesophyll cells at the vein endings, (3) it is inferred that the wall of the xylem vessel is not equally permeable to all the different solutes present in the transpiration stream, as is generally assumed.

31. Studies in the physiology of spike disease of sandal.

A. V. Varadaraja Iyengar, Bangalore.

I. *Mineral nutrition of sandal in relation to health and disease.*—A chemical examination of healthy and spiked plants revealed an abnormal metabolism of calcium and nitrogen in the diseased ones. While the affected leaves and twigs showed a diminished lime and potash, the corresponding roots were significantly rich in these constituents. There appears to be a mobilization of nitrogen reserve from the roots to stems and leaves which had a high nitrogen content. In any case, the ratio Ca/N is the surest index of disease in sandal.

II. *Carbohydrate metabolism of spiked sandal.*—The diseased tissues are characterized by an accumulation of starch from incipient stages of infection. This storage is traceable to a defective translocation of food materials with the onset of spike. In the advanced stages, the leaves are packed with starch and are also rich in soluble carbohydrates. The mechanism of excess sugar formation is probably from the fats already present in the leaves which, as a result of infection show a lower fat content. This heavy starch deposition can be readily accounted for, if a deficiency in calcium following infection is assumed.

III. *Nitrogen content of healthy and spiked sandal tissues.*—Although the nitrogen content of tissues changes considerably with the inception of disease. comparatively little is known of the distribution of nitrogen in the various plant parts. In the leaves, however, water soluble nitrogen was higher as a result of infection while protein nitrogen was relatively small. Further, the increase in ammoniacal nitrogen in the diseased condition is due to the presence of deaminase functioning therein.

IV. *Tannins and organic acids in health and disease.*—It is known that organic acids and tannins contribute towards the resistance of plants to disease and to insect attack. In the case of spike, all that is known relates to the preponderance of hydroxy acids such as malic and citric, in the early stages of disease, which are also distinguished by a high moisture content of spiked leaves. With the advance of disease or in virulent stages of infection. the presence of succinic acid exclusively in the affected tissues has been recorded. A process of desiccation also takes place with the progress of disease. This increase in organic acids combined with a high ammonia content is correlated with the occurrence of a highly active deaminase. The presence of an oxidative deaminase system would easily account for the formation of succinic acid. The possibility of this acid arising through dehydrogenase action on acetic acid has been tested with negative results. In healthy plants, malic acid is the chief component. The buffering action of diseased leaf juice is strong towards alkalies while it is weak towards dilute acids. This seems possible only when the respiratory activity is unusually high as in the present instance.

There is a distinct change in the nature of tannins with the onset of disease. While both pyrogallol and pyrocatechol groups of tannins have been found in sandal leaves the former type predominates in the diseased condition. In healthy ones, on the other hand, the catechol group is the chief component. These two types are found to affect the metabolic processes in different ways. The total tannin content however of spiked leaf tissues is twice that found for healthy ones. How this transformation takes place from one type to the other has not been examined.

V. *Metabolic disturbances in sandal leaves consequent on spike infection.*—Diseased leaves are characterized by a high diastatic activity. A greater deposition of starch than the normal is generally correlated by the physiologist with a low amylase co tent or a feeble diastatic action. In the present case, however, the increased enzymic power was traced to the presence of an activator in the form of pyrogallol group of tannins rather than to a higher enzyme unit. Correspondingly, catechol type is very poor in action.

The respiratory activity of spiked leaves alone was high while the corresponding twigs showed a less activity. Tender leaves however respire more carbon dioxide than mature ones. The presence of a powerful deaminase in spiked leaves was also established. Further work on this is in progress.

Photosynthetic activity of diseased leaves is comparatively less than that of healthy ones. The translocation of food material in sandal appears to be inhibited with the onset of infection.

32. Some observations on the structure of adhesive discs in climbing plants.

T. S. MAHABALE, Ahmedabad.

Adhesive discs were noted in *Vitis latifolia* Roxb., *V. trifolia* L., *V. carnosa* Wall, *V. repanda* Wight, *Luffa aegyptiaca* Mill, *L. acutangula* Roxb., *L. acutangula* Roxb. var. *amara* Roxb., *Trichosanthes cucumerina* Linn., *T. palmata* Roxb., *Melothria maderaspatana* Cogniaux., *B. venusta* Ker-Gawl., and their anatomy was studied with a view to follow the mechanism of adhesion. It was found that the main structural elements of a disc are constant in the various species examined.

In a transverse section of a disc the outermost layer is made up of sensory epithelium and hairs. Below this layer lies thin walled parenchyma with turgid cells; sometimes these are associated with cells having transverse pits on their walls. In a longitudinal section cells below the subjacent parenchyma, which are outside the stele, have starch granules lying on the physically lower side of the cells, strongly recalling statoliths.

Protoplasts in the sensory hairs undergo physical distortion when they come in contact with a hard and rough surface and thus seem to perceive the stimulus. Cells below the sensory layer are thin walled turgid, and somewhat elongated. Presumably they conduct the stimulus to the statocysts, create a disturbance in the statoliths, resulting in an appropriate curvature of the tendril. This, we may reasonably suppose, allows the sensory hairs to grasp the support and cement it. Mechanical elements are laid down next and adhesion becomes permanent after about twenty-four to forty-eight hours. It is suggested, therefore, that the structural peculiarities of the discs and the statoliths noted for the first time in them, are largely responsible for the mechanism of adhesion. Experimental work is in progress.

33. The effect of light on lipase activity.

N. L. Pal, Allahabad.

Effect of artificial light on the activity of lipase, a fat splitting enzyme, was studied. It was found that light had very little action on the hydrolysing capacity of lipase: but there was considerably greater condensation by lipase in light specially in the earlier periods, though light is not at all essential for this action. Thus there was greater synthesis of fat from fatty acids and glycerine by lipase in light than in dark.

34. The effect of light on respiration and conversion of fat to sugar in germinating Helianthus seeds.

N. L. Pal, Allahabad.

The rate of CO_2 output and oxygen intake goes on increasing with time in germinating *Helianthus* seeds and the respiration generally corresponds with the grand period of growth.

In the stages examined the R.Q. shows a fall from about 0·75 to 0·54 as the plants grow in length.

On exposure to light the CO_2 output and the O_2 intake show a fall thereby showing that some amount of photosynthesis is possible even in such young plants as these.

On the assumption that the R.Q. due to respiration is unity, the amount of oxygen taken in for fat to sugar conversion can be calculated. It is shown that this value rises progressively in dark and the rate of rise increases with time. However, on exposure to light there is not only a retardation in the rate of increase, there is an actual fall in later periods in light.

It has therefore been argued that the rate of fat to sugar conversion falls on exposure to light in these seeds.

35. The effect of violet and ultra-violet radiations on plant respiration.

S. Ranjan, Allahabad.

(1) The effect of light from an atmospheric murcury vapour lamp on plant respiration was studied. It was found that owing to a great reduction in the ultra-violet part of radiation, due to glass surfaces through which the light passed, and owing to the presence of other rays

in the light the effect was more or less similar to the effect of ordinary light on respiration.

(2) When exposed to rays passing through methyl violet solution so as to give monochromatic violet light, the respiration rate does not show any appreciable change.

(3) However, on exposure (8 minutes and 10 minutes at an interval of 2 hours) to direct light from this apparatus at a distance of 1 ft. containing a much greater proportion of ultra-violet radiation, the respiration of leaves shows a fall which slightly rises on switching off the light. Shorter exposures (3 minutes from a distance of one ft. at an interval of one hour) clearly proves the inhibitory effect of ultra-violet radiation on respiration. Weaker doses (3 minutes at a distance of 6 ft.) also have harmful effects though the inhibition is less marked.

(4) Sugar estimations show that there is no change in the reducing sugar content exposure to ultra-violet light.

Palæobotany

(*Chairman* : PROF. B. SAHNI.)

36. An analysis of the artificial genus *Palmoxylon* into natural genera.

K. N. KAUL, Lucknow.

In 1888 F. H. Knowlton (*Proc. U.S. National Mus.* : 89–91) wrote, 'So little is at present known regarding the internal structure of the living species that it is only possible in the present state of our knowledge to mass together all the fossil species under the comprehensive generic name of *Palmoxylon*, or simply "Palm-wood". It is true that the described species of *Palmoxylon* differ considerably among themselves and it is more than probable that characters will ultimately be obtained that will allow of a separation into several generic types.' Stenzel (1904 *Fossile Palmenhölzer. Beiträge zur Palæontologie und Geologie* : 123) had already noticed that the structure of the ground-tissue was distinctive of the different species of fossil palms.

In 1934-35 on the suggestion of Professor B. Sahni I investigated the stem anatomy of 63 species (belonging to 33 genera) of modern palms in the hope of finding vegetative characters which should enable one to make a natural classification of the Palmæ. As I then stated (Kaul, 1935, *Ind. Sci. Congr., Bot. Sec.*, Calcutta : 285-6) the characters of the ground-tissue, which takes its definitive form after the growth in thickness of the stem (see Schoute, 1912, '*Ueber das Dickenwachstum der Palmen*', *Ann. Jard. Bot. Buit.*, xi : 1–209) are of great value for distinguishing natural genera of palms. I then suggested that it is possible to classify the different genera on the basis of the ground tissue characters alone ; also that if this claim was justified, the highly artificial form genus *Palmoxylon* could be split up into a number of natural genera of which the affinities or even identity with modern genera could be ascertained with some confidence.

By a detailed comparison of the living species with the extensive fossil material, which Professor Sahni has been describing in an unpublished monograph, it has been found that *Palmoxylon coronatum* Sahni so closely resembles the modern palmyra palm, *Borassus flabellifer*, in all its anatomical characters, including the ground-tissue, as to raise the suspicion that the fossil species may actually be a petrified palmyra. Between the fossil species *P. mathuri* Sahni and *P. sundaram* Sahni on the one hand and the modern palms *Bactris pallidispina* and *Cocos nucifera* respectively on the other there are also such close anatomical resemblances that I believe the fossil forms belong to these living genera.

More extensive comparisons now in hand will, it is hoped, make it possible to split up the artificial genus *Palmoxylon* into its component natural genera.

37. A Lower Gondwana flora from the Salt Range, Punjab.

(MISS) CHINNA-VIRKKI, Lucknow.

These fossils, presented to Prof. B. Sahni by Mr. E. R. Gee, who collected them from two different horizons (a lower horizon A and a higher B), were kindly entrusted to the authoress for further investigation. The collection from A is important, as it belongs to the lowest plant-bearing horizon so far discovered in the Indian Gondwanas. It comes from the carbonaceous shales of the basal portion of the Speckled Sandstone series, from a horizon only about 20–25 ft. above the Talchir Boulder bed (Upper Carboniferous). Horizon B is formed by the carbonaceous shales just below the massive Middle Productus Limestones (Middle Permian). The material consists of incrustations and impressions. Cuticular preparations were made from the specimens marked *. Maceration of some of the shales yielded spores, which are recorded for the first time from the Palæozoic rocks of India. The identifications given below are provisional :—

	Horizon A.	Horizon B.
EQUISETALES.	? *Schizoneura* sp.	
CYCADOFILICALES.	Frond (fertile).	
	Sphenopteris sp.	
	? *Pecopteris* sp.	? *Pecopteris* sp.
	Glossopteris Communis, Fstm.	
	G. communis var. *stenoneura*, Fstm.	
	G. stricta, Bunb.	*Glossopteris stricta* Bunb.
	Glossopteris spp. (two).	* *Glossopteris* spp. (three).
	* *Gangamopteris* spp. (three).	*Vertebraria* sp.
GYMNOSPERM SEEDS	*Cardiocarpus* sp.	
	Samaropsis spp. (two).	
INCERTÆ SEDIS.	* Piece of cuticle with irregularly arranged cells.	* Narrow leaves with parallel veins. Cuticle resembles that of *Bennettitales :* transversely placed stomata arranged in rows. cell walls sinuous.
	Ottokaria-like frond, stalk long, margin round, base cordate, apex notched.	

SPORES (mostly from B) of varied shape and form and ranging from $25\mu \times 11\mu$ to $150\mu \times 110\mu$, can be classified as—

- (i) Unwinged—(twelve different kinds) smooth walled, tuberculate or spinous ; shape triangular, elliptic or oval.
- (ii) Winged—
  - (*a*) one wing all round,
  - (*b*) two wings (cf. *Pityosporites antarcticus* Seward).
  - (*c*) Three wings.

P.S.—Since the above was written I have visited the locality (Kathwai) where the lower horizon (A) mentioned above is exposed. In the same geological section two new plant-bearing horizons, only 1½ ft. and 4½ ft. above the Talchir Boulder Bed, were discovered, and from these horizons spores identical with some of those above described were obtained. These two horizons are now therefore the lowest plant-bearing Gondwana horizons yet recorded from India.

38. Jurassic plants from Afghan-Turkistan.

R. V. Sitholey, Lucknow.

This collection by Dr. C. S. Fox of the Geological Survey of India, lent to the author by Prof. Sahni, is interesting because it comes from definite horizons in isolated and remote localities.

The following is a provisional list :—

EQUISETALES ..	*Equisetites* sp.
FILICALES ..	*Cladophlebis denticulata* Brongn.
	Matonia-like fronds (fragments including only bases of radiating pinnæ).
	? *Laccopteris* sp. (pinnate fragments with a possibly reticulate venation).
	Coniopteris hymenophylloides Brongn.
	Sphenopteris sp.
	? *Haydenia thyrsopteroides* Seward. (sterile).
	Dictyophyllum sp.
CYCADOPHYTA ..	*Nilssonia saighanensis* Seward.
	Ctenis sp.
CONIFERALES ..	*Pagiophyllum* sp.
	Cones probably of *Pagiophyllum* sp.
	Mesembrioxylon sp.
INCERTÆ SEDIS ..	Axis bearing ? fructifications (cf. *Discostrobus argunensis* Krasser).
	Podozamites lanceolatus L. & H.
	„ „ L. & H. var. *latifolius* Heer.
	„ „ L. & H. *angustifolius* Seward.
	„ sp.

Fronds of *Matonia*-like habit are rare for this area, though *Dictyophyllum* has been reported from Afghanistan. In India, the first Matoniaceous fern (*Matonidium indicum*) has been described only recently by Prof. Sahni from the Lower Cretaceous (Wealden) of Himmatnagar (W. India). A fuller identification of the *Matonia*-like fronds from Afghan-Turkistan may throw more light on the geological distribution of the *Matonia-Dipteris* alliance.

As most of the specimens are either identical or closely allied to species described by Seward (*Palæont. Ind. New Series,* Vol. IV, No. 4, 1912) from Afghanistan, which he considers Jurassic, it appears reasonable to assign the same age to the Afghan-Turkistan beds.

39. Two petrified strobili from the Rajmahal Hills, Bihar.

A. R. Rao, Lucknow.

The description of the following types is based upon the study of some silicified blocks from Nipania (Jurassic) a preliminary account of which has already appeared (*Rao, Proc. Ind. Sci. Congress* 1934 and *Sahni, Proc. Zesde Internat. Bot. Congress, Amsterdam,* II, p. 248, 1935).

Nipaniostrobus Sahnii gen. et sp. nov.

Megastrobilus (possibly coniferous) with spirally arranged sporophylls each bearing adaxially a single ovule (1·5×·5 mm.) partly buried in the scale ; micropyle strongly curved, slit-like, facing the cone axis. Integument two layered, not fleshy ; outer (prismatic) layer thicker at the chalazal end of the ovule. Nucellus shrunken, with a black tip. The cone differs from all known fossil forms. The single ovule on each scale suggests the Podocarpineæ but further details are lacking. The real affinities are therefore quite obscure.

Masculostrobus rajmahalensis sp. nov.

Fragment of a longitudinally cut microstrobilus with sporophylls placed in a close spiral ; distal sterile lobes upturned and overlapping. Sporangia full of two-winged pollen grains (cf. Abietineæ and Podocarpineæ) measuring $54–60\mu \times 30–34\mu$ including wings, spore diameter about 30μ.

The material was lent by the Geological Survey of India to Professor Sahni at whose suggestion this work was undertaken.

40. Jurassic plants from Tabbowa, N.-W. Ceylon.

K. Jacob, Lucknow.

The fossils here dealt with were collected last June by the author in the company of Mr. T. S. Sadasivan from certain plant-bearing beds at Tabbowa in the North-West Province of Ceylon. The beds consist of non-marine deposits composed of sandstones, pipe-clay and ironstones. A few fragmentary plant fossils collected by E. J. Wayland were first described from this locality by Seward and Holttum (*Quart. Journ. Geol. Soc.*, Vol. lxxviii, pt. 3, 1922). The specimens in our collection are better preserved ; besides, several species not recorded from this locality (marked *) are also represented. The following is a provisional list :—

* *Sphenopteris* sp.
* *Coniopteris hymenophylloides* Brongn.
* *Cladophlebis cf. C. whitbyensis* (Göpp.).
* *Cladophlebis* sp.
Taeniopteris spatulata McCl.
* *Anomozamites* sp.
Brachyphyllum mamillare Brongn.
Elatocladus plana (Fst.).
? *Desmiophyllum* sp.

The flora, as already concluded by Seward and Holttum (*loc. cit.*), is undoubtedly of Jurassic age, and the locality represents one of the outliers of the Upper Gondwanas of the Coromandel Coast.

41. Fossil plants from Sakrigalighat in the Rajmahal Hills, with remarks on the age of the beds.

K. Jacob, Lucknow.

The plant-bearing beds consist of two main zones—a lower brittle zone (A) and an upper hard zone (B) (Jacob, *Proc. Ind. Acad. Sci.*, B, Vol. VI, 1937). From the latter only impressions were obtained, while the former yielded besides impressions, a number of non-carbonized incrustations as well. 'Film-transfers' and microtome sections of the chemically treated incrustations gave satisfactory results. The following is a provisional list of species collected from the two zones :—

Equisetales	*Equisetites* sp. (A).
Filicales	*Sphenopteris* (? *Coniopteris*) sp. (A). *Coniopteris hymenophylloides* Brongn. (A). ? *Thinnfeldia* sp. (A). *Cladophlebis indica* O. & M. A). Certain anatomical features of the midrib are seen.

	Protocyathea rajmahalense Jacob (l.c. 1937). (B).
Cycadophyta	*Ptilophyllum acutifolium* (Morr.). (A) and (B). Certain anatomical features of the midrib are seen.
	P. tenerrimum Fst. (B).
	* *Dictyozamites* sp. (A).
	Taeniopteris spatulata McCl. (A).
	Taeniopteris sp. (A). The structure of stomata is described.
	Nilssonia Morrisiana Old. (A) and (B).
Coniferales	? * *Elatocladus conferta* (O. & M.). (A).
	? * *Elatocladus* cf. *E. jabalpurensis* (Fst.). (B).
	Brachyphyllum expansum (Sternb.). (B).
	Pagiophyllum peregrinum (L. & H.). (A) and (B).
	* *Dadoxylon* sp. A rolled pebble, possibly from a different horizon.
	? *Frenelopsis* sp. (A).
Caytoniales	*Sagenopteris Bhambhanii* sp. nov. (A). The genus is for the first time described from the Indian rocks. Occasional anastomoses between the bifurcating arched secondary veins.
Incertæ	*Sakristrobus Sahnii* gen. et sp. nov. (A). Strobili of slender habit with delicate sporophylls arranged on an axis. Each sporophyll consists of a 'stalk' and a peltate lamina with reproductive bodies (? sporangia) arranged probably all round the 'stalk'.

The occurrence of the Cretaceous genus *Protocyathea* in the upper zone (B) either indicates that the beds in question are younger than the Jurassic, or it extends the range of this genus back into that period. If the beds are younger, the Jurassic facies of the vegetation had evidently persisted into the Cretaceous, because several typically Jurassic species of plants are associated with the *Protocyathea.*

The species marked * are the only ones previously recorded from this locality.

42. Cuticular studies of Magnoliales.

H. S. Rao, Lucknow.

In the present work the question of the position of the Magnoliales from the point of view of their epidermal features has been taken up. This is rather a new line of inquiry. Florin's criteria viz., the 'Haplocheile' and 'Syndetocheile' types of stomatal development have been made use of. According to this test the Magnoliales are seen to comprise a few synthetic forms, some possessing some Cycadean features, the great majority the Bennettitalean, and a few the haplocheile gymnosperm features.

The aberrant epidermal features of *Euptelea* and *Cercidiphyllum* seem to be correlated with other primitive features of Trochodendraceæ already known.

The view has again been expressed that the progenitors of the angiosperms have to be sought for in that plexus of Gymnosperms which gave rise to the Bennettitales, the syndetocheile Gnetales, the haplocheile Magnoliales and the majority of the Magnoliales (i.e., syndetocheile) along different lines of descent, *the last being probably nearest related to the Bennettitales.*

From the point of view of epidermal studies, the Magnoliales do not represent a co-sanguinary group, but indicate a convergence.

SECTION OF ZOOLOGY

President:—G. MATTHAI, M.A., Sc.D., F.L.S., F.R.S.E., F.N.I., I.E.S.

1. Evolution of the neuromotor apparatus and the skeletal structures of Trichomonads.

G. C. CHATTERJEE *and* A. N. MITRA, Calcutta.

Neuromotor organelles of Trichomonads originate from already existing ones. This is the usual method already known. Their origin and subsequent development from a cell containing only cytoplasm and nucleus and no other organelles have already been described by the authors in previous papers. In this paper they discuss how this complicated apparatus originates and becomes differentiated into flagella, undulating membrane, axostyle and parabasal, in the light of various views on the subject, specially the binucleate theory of Hartmann, the authors finding support of this binucleate theory in their study of development of the organelles of Trichomonads.

2. On a new coccidium *Eimeria koormæ* n. sp. from an Indian tortoise *Lissemys punctata* Smith.

M. DAS-GUPTA, Calcutta.

Thick-walled, unsegmented, fully spherical oocysts were directly recovered from voided fæces and rectal contents of an Indian tortoise *Lissemys punctata*. All the endogenous stages were studied in detail from sections of the intestine stained in iron hæmatoxylin. The mature oocyst marked by a pseudomicropyle measures $14 \times 14\mu$, and oocystic residiuum is absent. The spindle-shaped sporoblast measures $10 \times 4{\cdot}5\mu$, and contains sporocystic residiuum. A differential diagnosis of the known species of *Eimeria* recorded from Chelonia has been shown in tabular form.

The name *Emeria koormæ* n.sp. is proposed for the new coccidium.

3. On a new myxosporidian, *Henneguya otolithus* n. sp., a tissue parasite from the bulbus arteriosus of a marine fish, *Otolithus*.

P. N. GANAPATI, Madras.

Two species of a common edible sciænid fish *Otolithus ruber* and *O. maculatus* are found infected by a species of a myxosporidian *Henneguya otolithus* n. sp. The primary site of infection is the muscle and connective tissue of the wall of the bulbus arteriosus where the parasite forms whitish opaque cysts. The vegetative forms or trophozoites show a clear differentiation into an ectoplasm and endoplasm. Two kinds of nuclei, the vegetative and the generative, are present in the earlier stages of the parasite. The propagative stage, or pansporoblasts, originate by divisions of single generative cells. Each pansporoblast gives rise to two spores.

Autogamy is present, and evidence of auto-infection has been seen. The histo-pathological processes are characterized by an increase of blood supply to the infected area which often leads to inflammation.

Fibrosis takes place in the organ, when the fish recovers and degeneration products in the nature of yellow concretions are observed. Infiltration of spores have been noted in inefcted tissues. Isolated spores or groups of them have been located in the kidneys. A periodic variation in the occurrence of infection and the stages of the parasite has been observed. A higher temperature seems to accelerate spore formation.

4. Studies on Myxosporidia from fresh-water fishes of Bengal.

M. Chakravarty, Calcutta.

The author has given a detailed description of six new species of Myxosporidia belonging to the genera *Myxobolus, Ciratomyxa, Henneguya* and *Myxidium,* infecting different tissues and organs of fresh-water fishes.

5. Phylogeny and classification of the Sporozoa.

B. L. Bhatia, Punjab.

Sporozoa (*sensu stricto*) comprising Gregarinida, Coccidia and Hæmosporidia, phylogenetically distinct from Amœbosporidia, comprising Cnidosporidia, Sarcosporidia, and Haplosporidia. Chief trends of evolution within both groups. Gametocytes widely separated and produce gametes separately, which would become differentiated; zygote producing a number of sporoblasts, spores and sporozoites (Coccidia) ; or gametocytes associated and encysted together, producing gametes in close proximity which are consequently not differentiated (Gregarinida). Hœmosporidia closely related to Coccidia, but schizogony restricted to one host and sporogony to another. Zygote a motile vermicule which forms an oöcyst which persists only while sporozoites are being produced. Absence of spores with resistant cysts due to the parasite being always sheltered within body of the one or the other host.

Cnidosporidia, Sarcosporidia, and Haplosporidia are best regarded as independent sub-classes, having no affinities with one another or with the Sporozoa (*sensu stricto*).

Minchin regarded the union of the Telosporidia and Neosporidia in one class—the Sporozoa—as a quite artificial arrangement. Logically speaking they should be placed in two distinct classes and named as Sporozoa and Amœbosporidia, but the two classes cannot be regarded as constituting a subphylum, as the first are clearly derived from the Flagellata and the second from the Rhizopoda.

6. Indian Sporozoa.

B. L. Bhatia, Punjab.

Brief review of the study of Sporozoa in India. Certain gaps in our knowledge of the group. Some problems for future investigators.

7. Some fresh-water sponges from the Dal Lake, Kashmir.

Diwan Anand Kumar, Lahore.

The paper gives an account of a collection of fresh-water sponges made by Dr. Matthai from the Dal Lake. The examination of material has revealed the presence of two genera, viz., *Spongilla* and *Ephydatia.* Each genus is represented by at least one species. A comparison is made with allied species from other localities. These genera have been recorded for the first time from the Dal Lake.

8. Studies on the brackish-water anemone *Pelocoetes exul* Annandale, and on *Pelocoetes minima*, a new marine species from Madras.

N. Kesava Panikkar, Madras.

The structure and bionomics of *Pelocoetes exul* and of *Pelocoetes minima* sp. nov. dredged off the Madras coast, have been studied. The differentiation of the column apparent in *P. exul* is absent in *P. minima*; and the characteristic stinging warts of the former species are unrepresented in *P. minima*. The structure of the stinging warts and groups of nematocysts is described in detail. The cinclides of *P. exul* originate as ectodermal invaginations. The tentacular arrangement is on the same fundamental plan in both the species; in *P. minima*, however, only four cycles (total 48) of tentacles are observed, while there are normally five cycles (total 96) in *P. exul*. Remnants of an additional cycle are also occasionally present in the latter species. The fourth cycle of microcnemes noticed in *P. exul* is absent in *P. minima*. Sharp differentiation of the mesenteries into microcnemes and macrocnemes exists in both the species. Contrary to the opinion of Annandale and others, the oral disc of *P. exul* (as also that of *P. minima*) has been found to be retractile. Similarly, there is no evidence of hermaphroditism in *P. exul*. It has been found that the sexes are normally separate in this species as in all other species of the Halcampactiidæ. The distribution of cnidæ in the two species has been carefully followed. The acontial nematocysts include both penicilli and spirulæ. The intermediate tracts of the filaments of *P. exul* are peculiar in the possession of spirocysts. The habits and habitats of the two species are described, and the available information on the distribution of Indian Halcampactiidæ is summarized. The morphological peculiarities of the genus *Pelocoetes* and the systematics of the two species are discussed.

9. Two new species of blood-flukes belonging to the family Spirorchidæ Stunkard (Trematoda) with comments on the identity of the genera *Plasmiorchia* Mehra, 1934, and *Gomtiotrema* Sinha, 1934, and classification of the family.

H. R. Mehra, Allahabad.

Two new species of the genus *Learedius* Price, 1934, are described and their relationships with the known species discussed.

The genus *Plasmiorchis* Mehra is identical to the genus *Gomtiotrema* Sinha; the former name is accepted on the basis of priority.

The genus *Coeuritrema* Mehra syn. *Tremarhynchus* Thapar is not identical to *Hapalorhynchus* Stunkard as held by Price.

The classification of the Spirorchidæ is discussed in the light of several new genera created by Price.

10. On a new trematode, *Neoganada bara bankiae*, nov. gen., nov. sp., of the family Plagiorchidæ from the intestine of a fish (*Clarias batrachus*).

J. Dayal, Lucknow.

A large number of trematodes were collected from the intestine of *Clarias batrachus*.

The new form described in the present communication is related to *Leptophallus* and *Ganada*, but differs from both these in the following characters: the relative size of the two suckers, lobed testes, relative size and position of the cirrus sac and the vesicula seminalis, presence of a receptaculum seminis and yolk sac, distribution of vitelline glands, characters of the uterine coils, and the size of the eggs.

The paper concludes with a short discussion on the relationship of the new form.

11. On a new trematode, *Travassosstomum natritis* n.g., n.sp., from the intestine of the Indian river-snake, *Natrix piscator*.

G. D. BHALERAO, Muktesar.

Travassosstomum natritis n.g., n.sp., has been described in detail and its affinities discussed. The new genus has been defined and assigned to the new sub-family Travassosstominæ.

Specific diagnosis—*Travassosstomum* : Hind-body four times longer than fore-body. Intestinal cæca extend to one-half to three-fourth of hind-body. Holdfast organ circular. Testes transversely oval. Uterine coils extend from muscular bulb to anterior end of hind-body. Vitelline follicles thick along postero-lateral border of fore-body and over holdfast organ, sparse elsewhere. Eggs measure 0·097 to 0·11 × 0·05 to 0·072 mm.

Diagnosis of *Travassosstomum* n.g.—Travassosstominæ : Body divided into two portions. Holdfast organ almost round, extending posteriorly from Pharynx. Adhesive gland compact, at posterior border of holdfast organ. Testes in anterior half of hind-body, one behind the other. Pars prostatica absent. Ductus ejaculatorius very long. Ovary round, anterior to testes. Receptaculum seminis absent. Laurer's canal present. Vitellaria mainly in anterior part of body. Ductus hermaphroditicus present. Genital aperture ventral subterminal.

Type-species—*T. natritis.*

Diagnosis of *Travassosstominæ* n.sp.—Proterodiplostomidæ : Parasites of snakes. Pseudosuckers and ductus hermaphroditicus present. Ductus hermaphrodicus and the terminal portions of the genital ducts enclosed by a muscular bulb. Pars prostatica absent or rudimentary.

Type genus—*Travassosstomum*, other genus *Proalarioides*.

12. The incidence of cestode parasites among ovine hosts in the Punjab.

MOHAMMAD AMIN, Lahore.

Out of a total number of 335 ovines examined for cestodes, 184 were found to harbour the cestode parasites. These parasites occur more abundantly in some localities than in others, the infestation being greater in northern and central districts of the province than in the southern ones. There is, however, a periodicity in the sppearance of these worms, the percentage of infection-incidence being highest in July, August and September with a gradual decrease towards January and December. A table, showing the localities of origin and percentages of those infected animals, has been appended.

A certain amount of variation in the occurrence of various genera in different parts of the year, and in animals from different localities, has also been noticed. Tabulated statements showing relative frequency, seasonal variation and geographical distribution (as far as could be ascertained from the locality of the origin of host animals) of various genera met with have been prepared.

13. Two new species of *Avitellina* (Cestoda) from ovines in the Punjab.

MOHAMMAD AMIN, Lahore.

In this paper are described two new species of *Avitellina : A. spirillometra* n.sp. and *A. bigemina* n.sp., parasitic in the small intestine of ovines from the Punjab. The former species differs chiefly from the hitherto known members of the genus *Avitellina* in the convoluted form of the uterus, presence of anteuterine pouch—a structure described for the first time—and in the exceedingly small size of the paruterine organ. *A. bigemina* is distinct from the other species of the same genus in its peculiar bipartite form of the paruterine organ, the complete absence of the intersegmental fibrous pad, and in the size of various structures.

14. The occurrence of the cestode, *Helictometra giardi* (Moniez, 1879), in Indian sheep.

MOHAMMAD AMIN, Lahore.

In this paper the author reports the occurrence of *Helictometra giardi* (Moniez, 1879) Baer, 1927, hitherto unknown in Asia, from the intestine of sheep—*Ovis aries*—from the Punjab. The specimens of this species are identical, in general, with those described by previous workers. Certain discrepancies regarding the descriptions of the testes (Stiles and Hassal, 1893), uterus (Baer, 1927) and the genital pore (Moniez, 1871, Blanchard, 1891) are, however, noticeable; these structures have, therefore, been redescribed in the light of observations made by the author.

15. On a new nematode *Pseudaspidodera jnanendræ* n.sp. from peafowl *Pavo cristatus.*

G. K. CHAKRAVARTY, Calcutta.

The author examined a collection of worms of the nematode genus *Pseudaspidodera.* Notwithstanding the resemblances his specimens differ from the genotype in many respects, and he has erected a new species to accommodate these worms. In this paper he has dealt with the structural differences and discussed the affinity.

16. On the anatomy of *Lingula* sp.

P. R. AWATI *and* G. R. KSHIRSAGAR, Bombay.

The alimentary canal is straight in the anterior portion while it is looped posteriorly. The digestive glands—greenish in colour—are found to open into the stomach by their wide ducts. The circulatory system is very poorly developed, as there is no need for it. Food and oxygen are supplied by the cœlomic fluid. Nephridia are flat tubular structures, each with a nephrostome and a nephridiopore. They act as ducts of the reproductive organs which are lobulated masses. The sexes are distinct. The nervous system is also poorly developed. There are two ganglia—supra-, and sub-œsophageal; nerves to all parts of the body are supplied by these ganglia.

17. On the nephridia of *Prionospio cirrifera* Wiren.

R. GOPALA AIYAR, Madras.

Prionospio cirrifera, a tiny polychæte, occurs in large numbers in the brackish waters, Adyar. The worm measures 10–12 mm. and has about 50 segments. In segments 5, 6 and 7 there are three pairs of nephridia which are clearly visible through the body wall. All the nephridia are of the drain-pipe type, the lumen being intracellular. There are no nephridia in the middle and the posterior segments. Genital products escape by rupture of the body wall.

18. The nephridia of earthworms of the genus *Tonoscolex.*

K. N. BAHL, Lucknow.

In 1919 the author described a new type of excretory system in the Indian earthworm *Pheretima,* the essential feature of which is that the nephridia discharge their excretory fluid into the intestine all along its length instead of on to the surface of the body as in *Lumbricus.* This 'entero-nephric' type of excretory system was discovered later to occur also in earthworms of the genera *Lampito* (*Megascolex*) and *Woodwardiella.* As a result of these studies the author suggested a new classification of nephridia which has been adopted by Stephenson (1930).

In this paper the nephridial system of the genus *Tonoscolex* has been described, and assigned to its proper place in the scheme of classification of the oligochæte nephridia. An account of the blood-supply of the nephridia is also given and the question discussed as to how the classification of nephridia can be used as a basis for the revision of Stephenson's polyphyletic genus *Megascolex.*

19. A ciliated apparatus in the larva of *Echiurus.*

P. R. AWATI, Bombay.

This is a case of precocious development of a certain adult structure in a larva. In the adult the middle portion of the intestine has its ventral part modified into a separate tube through which fresh water is continually passing towards the posterior end of the animal. This water appears to be useful in aerating the coelomic fluid in which the alimentary canal is suspended.

A tubular and ciliated structure, with possibly a similar function, is found in the larva. It opens at both ends—anteriorly into the larval stomach and posteriorly into the rectum—the middle portion being coiled and slung to the outside of the larval stomach. The tube is double, with cilia in each lumen. There seem to be some valvular structures at either end which allow water to flow in through the rectum into the stomach and *vice versa.*

20. The circulatory system in *Thalassema bombayenis* and *Bonellia viridis.*

P. R. AWATI, Bombay.

Although the circulatory systems of *Thalassema* and *Bonellia* are similar to each other in general outline there are important differences between them. The ventral vessel which opens at the extreme posterior end into an intestinal sinus surrounding the intestine, is diffuse in *Thalassema,* but distinct in *Bonellia.* At the anterior end, the ventral vessel is continued into the proboscis in which it bifurcates into two branches. In *Thalassema* this anterior part of the vessel is closely attached to the ventral portion of the oesophagus, gizzard and the crop, and is enclosed by two entire sheets of the ventral mesenteries, one on each side of the vessel; in *Bonellia* this portion is entirely free from the oesophagus, etc., and passes between the two anterior setæ. The ventral vessel in *Bonellia* is connected with the intestinal sinus by a single transverse vessel, whilst in *Thalassema* the same is bifurcated at the base, and these two limbs pass, one on each side of the food canal, to the sinus which is very poorly developed. The dorsal vessel seems to emerge from the intestinal sinus at the anterior end; the latter is well developed in *Bonellia* while it is reduced in *Thalassema.*

21. On the metamerism of the Indian leech, *Hirudinaria granulosa.*

M. L. Bhatia, Lucknow.

The question of the limits of a somite of the leech has assumed great importance after the appearance of Castle and Moore's view and has led to a good deal of controversy.

According to Whitman the annulus bearing the segmental receptor-organs is the first annulus of a somite; while Castle and Moore regard the same as the central annulus in a complete somite. An attempt is made in this work to elucidate and support Whitman's limitation of a somite.

The evidence referred to in this paper is derived from the external morphology, internal anatomy, and embryology of *Hirudinaria granulosa.*

22. On the structure of the nephridia and 'funnels' of the Indian leech *Hirudinaria*, with remarks on these organs in *Hirudo.*

M. L. Bhatia, Lucknow.

In previous years an account of the nephridial system of the two leeches was given. In this communication the author discusses in greater detail the results of further observation on the following points :—

(*a*) Structure of nephridia in the two leeches.
(*b*) A fully developed 'funnel' (ciliated organ).
(*c*) Connection of these 'funnels' with the nephridia in the adult leech.
(*d*) Embryonic condition of the 'funnel' and
(*e*) Function of the 'funnel' (ciliated organ).

In the embryonic condition, the 'funnel' (ciliated organ) is a solid mass of cells which is distinctly continuous with the nephridium by means of a delicate strand of cells, the initial lobe. The funnel becomes enclosed, at an early stage, in the perinephrostomial sinus, which is a part of the reduced coelom; this connection of the 'funnel' with the nephridium snaps, and the two become discontinuous and discrete structures.

The 'funnel' is not a degenerate structure; it has become multiplied into numerous small ciliated funnels which are very effective in their ciliary action.

The central part of the 'funnel' (ciliated organ) is the seat of manufacture of blood-corpuscles which are thrown out into the surrounding sinus by the movements of cilia.

The ciliated organ, instead of serving a renal (excretory) function, has here become subservient to the sinus-system.

23. On some leeches from the Dal lake, Kashmir.

M. L. Bhatia, Lucknow.

In September, 1936, Dr. Matthai made a collection of the fauna of Dal lake, Kashmir. It included some leeches also which he very kindly entrusted to me for systematic and morphological study.

They have been identified as follows :—

Suborder—Rhynchobdellæ :

Family—Glossiphonidæ :

1. *Glossiphonia complanata.*
2. *Theromyzon* (sp ?)
3. *Hemiclepsis marginata asiatica* Subsp.

Suborder—Arhynchobdella.
Family—Erpobdellidæ :
4. *Erpobdella octoculata.*

Some interesting points with regard to the morphology and habits of these leeches are dealt with in the paper.

24. Entomostraca of the Dal lake, Kashmir.

G. L. Arora, Lahore.

The paper contains the results of a systematic and ecological study of the Entomostraca collected from the Dal lake, in September, 1936. Of the twelve species described, three appear to be new to science. The Cladocera are represented by four genera viz. *Simocephalus, Latonopsis, Ceriodaphnia* and *Macrothrix*, the Ostracoda by four genera viz., *Stenocypris, Pionocypris, Eurycypris* and *Cypria*, and the Copepoda by three genera viz., *Diaptomus, Limnocalanus* and *Cyclops.*

25. Diseases transmitted by Indian species of ticks in India and other countries and the possibility of their prevention through biological control.

M. Sharif, Aligarh.

Compared to what is known in other countries about the tick-borne diseases, very little appears to be on record in India. A brief summary of previous work done on this line is given. The writer has tried to show that the tick problem in India is as serious as in the United States of America, where enormous amount of money is being spent upon the control of ticks every year. To give an idea of the extent to which Indian ticks are concerned in the transmission of diseases, the author has listed those Indian species which have been incriminated either in India or in other countries. In man the ticks transmit the causative agents of the relapsing fever almost all over the world, and of the tick typhus fever in India. In domestic animals they transmit diseases caused by *Babesia, Theileria, Spirochæta,* and *Anaplasma* and some of the virus diseases. A suggestion as to the possibility of the control of ticks through the agency of parasitic and predaceous enemies is made.

26. Observations on the growth of the green mussel, *Mytilus viridis* L., in the Madras harbour.

M. D. Paul, Madras.

Mytilus viridis L., the green mussel, living in the Madras harbour grows at a very rapid rate and often reaches a size of nearly 100 mm., or 4 inches, in about 16 months. Growth has been found to be continuous and ‘ annual rings ’ or ‘ check marks ’, which are a result of cessation or reduction of growth during winter in the temperate seas, have not been observed in this form. Methods of studying the rate of growth under natural conditions are described.

This form attains sexual maturity in 48 days after attachment, a fact which is very interesting when compared with *Mytilus edulis* L., which takes nearly a year to mature on the English coast. *M. viridis* probably reaches its maximum size in 2 to 3 years. Intense breeding occurs from March or April to October, but ripe individuals of both sexes can be obtained throughout the year.

27. Observations on the growth and habits of *Pyrazus palustris* (Linn.) in the Andamans.

H. SRINIVAS RAO, Calcutta.

The occurrence of *Pyrazus palustris* (Linn.), a gastropod belonging to the family Cerithiidæ, in very large numbers in rock-pools in the neighbourhood of Port Blair gave the author the opportunity to study the growth of this species by the majority-size method. All except the very young individuals below 10 mm. in height which were found in the locality were measured in the course of five months commencing December, 1934. With the measurements of height obtained, a curve is plotted which shows that there are three distinct age-groups represented in the population namely, the 5 mm. group, the 20 mm. group, and the 40 mm. group. These the author believes, represent the broods of three different years. The absence of young individuals below 10 mm. in height during the months December, 1934 to April, 1935, and their occurrence in large numbers in May, 1935, despite the absence of mature females or their eggs in the locality, has led the author to conclude that the area has been colonized by a sudden incursion of veligers from the open sea carried by the tides.

A subsequent measurement of the entire shell population in the same locality in February, 1936, 9 months after the place had been depleted of all the shells above 10 mm. in height, shows that the young shells of the 5 mm. age-group has, during this period reached a stage intermediate between the 5 mm. and the 20 mm. age-groups.

The capacity of individuals of the species to survive adverse conditions in regard to food is inferred from laboratory experiments which are detailed in the present note.

28. A preliminary note on the stomach and the probable function of the cæcum of *Pila*.

T. K. GOPALACHARI, Cocanada.

The present note records the ciliary currents in the stomach of *Pila* not recorded so far. It also records two openings of the ducts of the digestive gland in the semilunar pit of the stomach, not one as described by Prashad. Ciliary currents over the ridges and grooves in the semilunar pit carry from these openings fine matter, probably excrement from the digestive glands, to the pyloric chamber along with a copious secretion of mucus. A groove in the pyloric chamber leads through the cæcum into the intestine. The cæcum probably helps in the formation of fæcal pellets.

29. A further study of the digestive gland of some Melaniidæ.

R. V. SESHAIYA, Annamalainagar.

This paper discusses the changes noticed in the digestive gland of some Melaniidæ as a result of parasitism by larval trematodes, æstivation, starvation, normal and experimental feeding with different kinds of material. The species employed for investigation are *Melania* (*Radina*) *crenulata* (Desh.), *Melanoides tuberculatus* (Müller), *Melanoides scabra* (Müller) and *Paludomus tanschaurica* (Gmelin). By prolonged feeding with non-digestible material, like finely ground Indian ink, it was possible to induce increased elimination of the material from the digestive gland. This is accompanied by histological changes, chiefly in a marked increase in the number of the secreting cells. The function of the digestive gland is briefly discussed.

30. On a new ascidian from Bombay, *Ecteinascidia bombayensis* n.sp.

S. M. Das, Lucknow.

The author describes a new species of *Ecteinascidia* (*E. bombayensis*, fam. Clavelinidæ) collected from Bombay. This forms a preliminary note for a more extensive report on the ascidians of the Indian coasts. The present species can be distinguished from other existing species by the following characters: the siphonal apertures are 5-lobed; the tentacles are of three lengths and about 64 in number; the posterior dorsal-languets are long, conical and distinct; the transverse muscles completely encircle the pharynx; the internal longitudinal bars bear projections comparable to papillæ; the stomach has folds in its walls. Ten to twelve individuals form a colony, each individual being attached by a peduncle to a basal stolon network. Development is internal, the pharynx acting as a brood-pouch; and the young are discharged into the sea as fully developed tadpoles.

31. A case of commensalism between a lamellibranch and a monascidian.

S. M. Das, Lucknow.

The author describes a case of commensalism between the Indian monascidian *Herdmania pallida* and a lamellibranch *Musculus coenobita*. This association is quite common in the collection made around the South Indian seas. Almost 80% of the monascidians collected by the author had one or more lamellibranchs imbedded in their test. One specimen of *Herdmania* had as many as 40 lamellibranchs of different sizes in its test. They are found more often at the free, than at the fixed, end of the ascidian, and in larger numbers around the branchial, than around the atrial, siphon. Except for a small siphonal cleft, each individual is almost completely imbedded in the test-substance. The author gives a short description of the shell, mantle, byssus, gills, and foot of this lamellibranch.

32. On some tunicates from Karachi.

Shadi Lall, Lahore.

The paper deals with the ecology of simple ascidians of the Manora coast, Karachi, and gives an account of two species of the genus *Stylea* from the same locality. *Stylea* is characterized by the presence of simple tentacles, eight folds in the pharynx and by the narrow loop of the intestine. The genitalia consist of a pair of ovaries surrounded by a number of spermaries, and are generally situated on the right. The two species differ from each other in the number of longitudinal bars in each fold and in the number of stigmata in each mesh.

33. Observations on the reproductive system, egg case and embryos of *Chiloscyllium griseum* Mull. and Henle.

R. Gopala Aiyar *and* (Miss) K. P. Nalini, Madras.

A description of the reproductive system of *Chiloscyllium griseum* and its egg case is given. Two embryos, one 30 days old and the other 70 days old, are described. The period of reproduction is rather restricted for tropical conditions and extends from December to April. The time taken for development of the egg into a full-grown embryo is 2½ months. Egg liberation is probably in pairs in quick succession.

34. Observations on the structure and function of the nidamental glands of *Chiloscyllium griseum* Müll. and Henle, with a note on the formation of the egg capsule.

(MISS) K. P. NALINI, Madras.

Chiloscyllium griseum is a typically oviparous Indian Elasmobranch. The nidamental glands are very prominent and active, and secrete the egg albumen and egg case. They are pear-shaped structures, divided by an incomplete transverse band of parenchymatous vascular tissue, into a cranial and a caudal portion. The cranial region is further differentiated into three parts, an albumen secreting zone, a narrow intermediate mucus secreting portion, and lastly, a cranial shell secreting region. The caudal portion comprises of densely packed shell secreting, as well as mucus, tubules which are very narrow.

All the gland tubules are simple and almost similar in structure consisting of gland cells and ciliated cells. The detailed structure of the different parts of the gland is described. The method of secretion inside the gland tubes and the laying down of the albumen and shell layers are dealt with in detail.

Comparison of the nidamental organs of *Chiloscyllium griseum* with those of *Scyllium canicula* and a few viviparous Madras Elasmobranchs is instituted.

Various views in regard to method of capsule formation are also described.

35. Preliminary observations on the structure of the uterus and the placenta in *Scoliodon sorrakowah*.

(MISS) G. MAHADEVAN, Madras.

Scoliodon sorrakowah is a common form found in the Madras Coast, and is viviparous. The ovary, in all the specimens examined, consisted of very small ova, even smaller than the ova of frog. Considerable growth of the embryos takes place in the uterus. The walls of the uteri which are at first spongy and thick-walled, become very thin, and lose their elasticity, due to their distension as the embryos grow. The lumen of the uterus is divided into as many compartments as there are embryos, and at the base of each compartment is a trophonemata, a prolongation of the uterine mucosa. This invaginates at its distal end in the form of a cup, into which the yolk sac fits and is almost completely enveloped, thereby forming a yolk sac placenta. As the embryo grows, the yolk sac becomes bigger, and the trophonematous cup less and less concave, till a stage is reached when all connection is completely severed. The yolk sac contains very little yolk and is a round spongy vascular structure. The placental cord is closely beset with appendicula, and their structure has been described. The function of the latter is to absorb nutritive fluid secreted by the inner epithelium of the uterus.

36. Notes on the biology of a freshwater grey-mullet, *Mugil corsula* Hamilton, with observations on the probable mode of origin of aerial vision in fishes.

S. L. HORA, Calcutta.

Mugil corsula Hamilton mostly lives in freshwaters and has the remarkable habit of swimming near the surface with its eyes prominently projecting out of the water. Observations are recorded on its locomotion, aerial vision, respiration, feeding and breeding. The habits of the species indicate that the fish probably acquired them in the estuaries during the transition period from the marine to the freshwater life. The evolution of the aerial vision in *M. corsula* is attributed to its habit of feeding at the surface on floating organisms. For this purpose an effort had to be made to raise the ventral mouth to the surface level, with the consequence that a part of the head and the snout was being continually pushed out of the water and thus an inducement was provided for the development of the aerial vision. It is pointed out that terrestrial Gobies, like *Periophthalmus* and *Periophthalmodon*, also acquired aerial vision in the same way as *M. corsula* while still living in water and later took to life on the land.

Reference is made to the remarkable modifications of the eyes in *Anableps*, a cyprinodont of tropical America, and it is indicated that such a structure could not be regarded as the first stage in the evolution of vision in the air. The probable causes that may have influenced the evolution of bifocal vision in *Anableps* are briefly indicated.

37. On the bionomics, structure and physiology of certain air-breathing gobies, *Periophthalmus koelreuteri* (Pall.) and *Boleophthalmus boddaerti* (Pall.).

B. K. Das, Hyderabad (Deccan).

Periophthalmus and *Boleophthalmus* have been studied in detail during the months of March, May and June in the backwaters and mud flats of the rivers Adyar and Cooum in Madras. They are to be found in large numbers in the early morning, but after sunrise as the water gets heated the fishes gradually retreat and bury themselves in the cool liquid mud, only occasionally coming to the surface for breathing atmospheric air. *Periophthalmus* is carnivorous, living on crustaceans (Gammaridæ) and insects. *Boleophthalmus* is herbivorous, and lives chiefly on vegetable matter (mostly diatoms) and débris, mixed with small quantity of mud.

Both genera carry on aerial respiration by taking gulps of air, with widely open mouth and bulging their opercular cavities, the latter serving as principal receptacles for air. They also use their gills for breathing, by occasionally dipping their heads and thus moistening the respiratory surfaces. The special character of the opercular chambers and their modifications due to air-breathing habit are discussed. The special type of blood-supply to the organs of aerial respiration is described. The structure and characteristic features of the gills and the secondary branchial folds, as well as those of the mouth-cavity are noted. The view regarding caudal respiration in *Periophthalmus* is rejected.

Behaviour of these fishes has been observed in dry atmosphere, wet grass, mud, atmosphere of CO_2 and Chloroform vapour. Effects of injury to opercula and gills have been noted.

Experiments have been carried out with regard to semi-asphyxiation in sea-water and revival period, complete asphyxiation varied under different conditions. Cardiac beats have been carefully noted in the fishes asphyxiated in different media. Causes and nature of adaptations, and the evolution of the air-breathing fishes are discussed.

38. On the structure and functions of the so-called Pyloric cæca in two genera of fishes, *Lactarius* and *Osphromenus*.

M. Rahimullah, Hyderabad (Deccan).

In *Lactarius delicatulus* the intestine is simple and short, forming two loops, as is usually the case with carnivorous fish. The stomach is flask-shaped and of moderate size. Cæca are six in number, and are arranged in two groups, four in the right group and two in the left. They vary in length, and when the fish is opened from the ventral side only their distal portions are visible, the proximal ends being hidden by the large liver.

In *Osphromenus gourami* the stomach is of enormous size. The intestine is of considerable length, evidently correlated with a purely herbivorous habit. The cæca are two in number, and are situated one on each side of the stomach. The right cæcum is longer than the left, and usually the proximal half of each is covered over by the liver.

The vascular, and nerve, supplies to the cæca in both *L. delicatulus* and *O. gourami* are discussed.

In *O. gourami* the longitudinal muscle layer is comparatively thin, about $\frac{1}{3}$ of the thickness of the circular muscle layer; the latter is not so thick as in most other fishes examined. Submucosa is also relatively thin, and consists of a loose net-work of connective tissue fibres, including a few blood capillaries and cut ends of nerves. Cæcal villi are fairly well developed, and project inwards, about half way across the diameter of the cæcal lumen. There are no cilia on the epithelial cells, and amongst the latter some ovoid mucous-secreting cells also occur. There is no trace of muscularis mucosæ and Brünner's glands, the crypts of Lieberkühn are quite prominent.

In *L. delicatulus* the muscle layers are very thin, especially the longitudinal, and the submucosa is fairly loose. The mucosa is highly developed, including prominent cæcal villi and a large number of more or less round mucous cells. The crypts of Lieberkühn have much wider ducts than in *O. gourami*. Towards the proximal part of the cæcum two or more villi may unite by their free ends, thus forming large intercommunicating passages.

39. Sexual dimorphism in *Tetrodon* sp.

D. Waman Bal, Bombay.

There are no definite external characters by which the sexes of this fish can be distinguished. An attempt has, therefore, been made in this paper to establish certain correlations of structures between the two sexes. They are carried out by measurements of the length of the whole body and also of various other parts. It appears from these measurements that the average length of the body and also of the different parts of the fish seem to be greater in the female than in the male.

The material for the present paper was obtained from Bombay docks and was examined in fresh condition.

40. On the fishes of the Dal Lake, Kashmir.

Nazir Ahmad, Lahore.

In this paper the author deals with the fishes collected from the Dal Lake during September, 1936. Six species belonging to six genera (*Schizothorax*, *Oreinus*, *Labeo*. *Nemachilus*, *Botia* and *Cirrhina*) of the family Cyprinidæ and one species of *Exostoma* of the family Siluridæ are represented in the collection. The latter was collected mainly from the Tel Bal Nala which is connected with the lake, while *Nemachilus* was netted both from the Nala and the lake.

41. On the development of the vertebral column in *Salamandra salamandra* (Linn.).

H. K. Mookerjee, Calcutta.

Previous workers have stated that the centrum is formed by the bases of the basidorsals in addition to the skeletogenous layer, but actually only the skeletogenous layer aggregates round the notochordal sheaths to form the hour glass shaped centrum on which the basidorsals stand. In the intervertebral region there is only one centre of chondrification instead of a pair of interventrals and interdorsals. This intervertebral cartilaginous ring has been cut by a strand of migratory connective tissue cells in a cranio caudal direction. A split is formed within the line of migratory cells so as to form a condyle in front and a socket at the back of each centrum, resulting in an opisthocoelous centrum.

Each neural arch in the trunk and tail, has not only a cartilaginous arch in the middle region, as has been described by the previous authors, but in addition, a connective tissue arch on either side of it, which without passing through the stage of chondrification becomes a membrane bone.

Contrary to the previous workers' views regarding the ossification of the cartilaginous arch as such, the cartilaginous arch degenerates. The degeneration of the cartilaginous cells and of inner perichondrial layer of basidorsals take place. So that the adult neural arch of *Salamandra salamandra* is made up of membrane bone the only exception being supradorsal element which becomes a cartilaginous bone and becomes a massive structure.

In the trunk vertebra the hæmal arch as such is not present but there are hæmal arch elements on the two lateral sides of the centrum. A portion of this hæmal arch element is present corresponding to the middle region of the centrum which may be made up of cartilage but in most cases this is also a membrane bone like the membrane bone element of hæmal arch at the anterior and posterior portions of the centrum.

In the vertebra just in front of the pelvic girdle there is a trace of cartilaginous basiventral at the ventral aspect in a paired condition which Goeppert, by mistake, has shown to be present throughout the trunk vertebræ.

In the tail vertebra the condition of the hæmal arches is like that of the neural arch, but the previous workers were of opinion that they have only one cartilaginous arch at the middle of each centrum. The degeneration and the existence of the third piece of cartilage as infraventral are also like the neural arches which nobody has noted previously. The hæmal arch is also made up of membrane bone in the adult condition except the infraventral cartilage.

Rib-bearing process is not formed from the basal stump as upward growth of the hæmal arch as stated by Goette and Goeppert but formed independently and ultimately become joined after coming downwards, with the basal stump. The rib is not a part of the rib bearer but formed in the horizontal septum and ultimately joins with the rib bearer at two points.

42. Observation on the course of the facial vein and the formation of the external jugular vein in an American bullfrog *Rana catesbeiana.*

J. L. BHADURI, Calcutta.

In a previous paper the author established three types of arrangements of the course of the facial vein from examinations of some Indian frogs and toads Unlike the condition found in *Bufo, Hyla* and *Uperodon* (=*Cacopus*) on the one hand and the European frogs (*Rana*) on the other, the facial vein takes a binary course in *Rana catesbeiana*, as is found in a few Indian ranids, one continuing as the cutaneous vein and the other turning back to open into the internal mandibular vein. The author advocates the use of the name facio-mandibular vein for that part which is formed by the union of the facial and the internal mandibular veins.

43. Buccal participation in the respiratory mechanism of the Chelonia.

G. P. GNANAMUTHU, Madura.

The respiratory mechanism of the chelonia is complicated by the development of the bony carapace and plastron. Several muscles found in the vicinity of the lungs have been considered to be of respiratory significance, but recently it has been held that the rotation of girdles must be solely responsible. The rôle played by the buccal cavity has been minimized, if not neglected. The author finds the buccal cavity, supported by the hyobranchial skeleton and its muscles, capable of dilation and contraction and thus supplement the action of the thorax in ventilating the lungs.

44. The arterial system of the mud turtle, *Lissemys punctata.*

(MISS) B. K. DHILLON, Lahore.

The arterial system of *Lissemys punctata* has been studied by injecting the animal either with aqueous carmine or with gum arabic mass and fixing the animal in rectified spirit.

The heart in *Lissemys* has not the conical shape, which is typical in reptiles. Owing to a peculiar twist to the right of the median plane, the arches and venæ cavæ of the left take a longer course to reach the heart than those on the right. The origin of the subclavians and vertebral arteries is shifted so far forwards that they arise in common with the carotids from the right systemic arch through the innominate. The carotids are comparatively long owing to the elongation of the neck, and give arteries to the vertebral column (cervical region). The internal carotids of the two sides form a loop in the pterygoid through which they pass. Blood is supplied to the alimentary canal by two main vessels which arise from the left systemic arch, instead of from the dorsal aorta. The dorsal region of the vertebral column is supplied anteriorly by vessels from the anterior epigastric and posteriorly by a branch on each side from the sciatic arteries. There is a single pair of urinogenital arteries. Ductus caroticus, ductus Botalli, external carotids, vertebrals and caudal artery are absent.

45. Remarks on the exhibition of very young embryos from a tigress (*Panthera tigris tigris*, Linn.), shot in Hyderabad (Deccan).

M. RAHIMULLAH *and* B. K. DAS, Hyderabad (Deccan).

The paper deals with three very young embryos (two males and one female), measuring from 4·2 cms. to 4·4 cms. in length (the tail being about 9 mm. in length). Fore-limbs and hind-limbs, though very small (about 9-10 mm. in length), possess the full complement of fingers and toes respectively, without claws. Eyes, nostrils and mouth are complete, but external ears are in process of formation. The uteri were uninjured, and two embryos were found in the right and one in the left uterus.

From various accounts it appears that breeding in tigers probably takes place all the year round, and that 3 or 4 cubs usually constitute the litter, but even 5 to 7 have been recorded. It would appear that the embryos under investigation might be estimated at 4 to 6 weeks old.

46. Chromsomes of the American bullfrog *Rana catesbeiana.*

A. B. MISRA, Benares.

The equatorial plates of the spermatogonia of *Rana catesbeiana* show 26 chromosomes only in the metaphase, the garniture being made up of 14 large and small V's, 8 large and small J's and 4 rod-shaped chromosomes. Thirteen bivalents and thirteen monads are accordingly present in the equatorial plates of the primary and the secondary spermatocytes respectively in their metaphases. This discovery brings the chromosomal complex of *R. catesbeiana* into a line with other species of this genus which have been karyologically studied and disproves the validity of Swingle's results.

47. A preliminary note on the sex-chromosomes of *Paludomus tanschaurica* (Gmelin).

R. V. Seshaiya, Annamalainagar.

The author has made a series of preparations illustrating the spermatogenesis of *Paludomus tanschaurica* (Gmelin). In the formation of the eupyrene sperms, the phases of the first meiotic division show the sex-chromosomes very clearly. In the diploid groups the sex-chromosomes can usually be recognized in the midst of the autosomes. In the first spermatocyte division the X and Y chromosomes show marked precession. The difference in the size of these chromosomes is also very striking, the X-chromosome being larger and curved and the Y-chromosome being in the form of a small round body. The diploid number of chromosomes in the species is 18.

48. The yolk-nucleus of Balbiani.

D. R. Bhattacharya *and* M. D. L. Srivastava,
Allahabad.

An attempt has been made to summarize the existing knowledge of the origin, structure and functional significance of the yolk-nucleus of Balbiani. The various views with regard to its homology and constitution have been discussed. It has been shown that if we accept the centrosomal nature of the clear vesicles lodged in the centre of the spider 'Dotterkern', and the mitochondrial character of the enclosing lamellæ, the difficulties surrounding the task of homologizing the typical spider yolk-nucleus of Van Wittich and others with those reported from the eggs of other classes of animals—vertebrates and invertebrates—are solved to a great extent. The yolk-nucleus then can be defined simply as the centrosomal area of the oocyte carrying on accumulation of mitochondria and other cytoplasmic components. The grounds on which the central vesicle can be accepted as the homologue of the somatic centrosome (Balbiani) and the lamellæ as the modified mitochondria have been briefly discussed, and attention has been directed towards the necessity of further research on the subject.

49. Studies on the structure of the golgi apparatus. IV. Endostyle of *Branchiostoma indicum* (Willey).

M. K. Subramaniam, Madras.

An analysis of the previous literature on the Golgi apparatus shows that views regarding the existence of a network in vertebrates had changed from time to time. A list of representative tissues where a Golgi apparatus is recorded in vertebrates is given. A perusal of the list shows that a network does not occur in all tissues. Neither can a 'Golgi zone' be postulated. The terminology and the conceptions of the shape and structure of the Golgi apparatus are so confusing that an attempt has been made to clarify some of the issues. Though the analysis was made in order to see whether a clue might be available as to the probable mode of attack of the problem of the evolution of the network like Golgi apparatus, the accumulated knowledge regarding the Golgi apparatus does not enable one to select any particular animal or tissue where such evidence may be expected. The study of *Branchiostoma* was undertaken under the belief that some clue regarding the evolution of the network may be found. No such evidence, however, was actually obtained.

Each group of mucus secreting cells seems to be in a particular stage of secretory activity. The variations in activity between the individual cells in a particular group is very small. It is generally observed that while two groups of gland cells are loaded with mucus, the other two are at the beginning of the secretory cycle.

The mitochondria which appear as a few large grains in the cells at the beginning of the secretory activity breaks up into small granules before mucus droplets put in their appearance. Most of these mitochondrial granules are extruded with the mucus droplets.

The Golgi apparatus occurs as a few small grains having an indefinite distribution. There is no 'Golgi zone' and neither are these elements collected around a centriole. These elements increase in size and number and as they do so, in many of them the central area becomes brownish. The elements finally get scattered through the cell. This scattering is soon followed by the appearance of mucus in the chromophobic areas of the Golgi elements. Increase in size of the secretion droplets leads to rupture of the chromophilic portion in regions where it is thin and the mucus globules with Golgi caps may be seen in the cytoplasm. Most of the Golgi elements degenerate and those left behind apparently reorganize for the next secretory cycle.

The recent work of Hirsch and Duthie are discussed and it is shown that unless equal importance is given in future studies to the shape and structure of the Golgi apparatus and mitochondria as is at present given to the function of these cytoplasmic components we cannot accept the claims put forward by the above workers. There appear to be exceptions as such, critical evidence is necessary.

50. The spermatogenesis of *Clibanarius padavensis.*

(MISS) C. K. RATNAVATHI, Madras.

The testes of *Clibanarius padavensis* present the seminal elements in various stages of growth, primary and secondary spermatogonia and spermatocytes, spermatids as well as fully mature sperms being recognizable in their testicular tubules. The spermatogonial number of chromosomes is hundred and sixteen. A centrosome, chromatoid bodies, golgi and mitochondria are present in the cytoplasm. The first spermatocyte division is reductional. The spermatid has a spherical, granular nucleus to begin with but with the transformation of the spermatid it becomes vesicular. The golgi bodies fuse to form an acroblast and this secretes a ring-like acrosome which later fuses with the rim of the nucleus which has by now become cup-shaped. The mitochondria fuse to form a vesicle which settles in the cup of the nucleus. The centrosome divides into two, and one of them settles in the centre of the nuclear cup while the other forms a ring-like structure at the distal end of the mitochondrial vesicle. The central body grows out from the proximal centrosome and extends to the distal centrosomal ring. Six tufts of spines now grow out from the cytoplasm surrounding the nucleus and the formation of the sperm is completed. The sperms get enveloped in spermatophores as they pass down the deferent duct and explode in a characteristic manner when placed in dilute salt solutions.

51. Spermatogenesis in the common Indian pigeon *Columba livia domestica.*

S. N. MEHROTRA, Benares.

The Golgi bodies of the spermatocytes, along with the idioplasm, coalesce to form a definite mass in the spermatid which establishes itself at an appropriate place against the nucleus to give rise to the acrosome. The nucleus, during spermateleosis, elongates both in the direction of the acrosome granule and the centriole. Mitochondria, which lay scattered in the cytoplasm of the spermatogonia and the spermatocytes, then become plastered round the fibril which develops between the proximal and the distal centrioles. This mitochondrial cluster eventually gives rise to the middle piece of the spermatozoon, the proximal centriole forming the neck. The flagellum of the spermatozoon is formed from the free portion of the axial filament of the spermatid. Lastly, the sloughing off takes place after which the spermatozoa mature. Heads of the immature spermatozoa show a complex network, or spirals, of chromatin in their interior. Such a structure has been reported by Wilson in the case of *Gallus*, and by Guyer in the case of *Columba*. The structure, distribution, and behaviour of the cells of Sertoli have also been described, and the differences between the mature and the immature spermatozoa indicated.

52. The decapod sperm.

VISHWA NATH, Lahore.

In 1932 (*Quart. J. Micr. Sci.*) the author gave an account of the structure and transformation of the spermatid into the spermatozoon in the brachyuran fresh-water crab, *Paratelphusa spinigera*. The homologies of various weird structures described by earlier workers were worked out in the light of modern literature, and it was made clear that the crab sperm, in spite of its fantastic form, is with respect to its components exactly like a typical sperm. In 1937 (*J. Morph.*) the author showed that the sperm of the macruran, *Palæmon lamarrei*, on the contrary, presents some atypical features.

A detailed study of the spermatogenesis of the hermit-crabs *Coenobita rugosus* and *Clibanarius longitarsus* made at Krusadai during the summer of 1937 has brought out several interesting and atypical features: (1) the Golgi material degenerates during spermateleosis, as in *Palæmon lamarrei*, and consequently the acrosome is conspicuous by its absence, (2) there is differentiated in the axial region of the cytoplasmic vesicle, which is of mitochondrial origin, a chitinoid tube, in which the enlarged centrosome is safely lodged, (3) the formation of the chitinoid tube seems to be associated with the fact that the centrosome remains single and does not perform the plugging function, so conspicuous in *Paratelphusa* and *Palæmon*, (4) the spines are, as in *Palæmon lamarrei*, cytoplasmic in origin and spring up from the region of the centrosome, but in *Clibanarius longitarsus* there is evidence pointing towards the conclusion that the spines are in reality bundles of axial filaments, (5) on two occasions the sperms of *Coenobita rugosus* were noticed to perform slow movements, using the spines as fulcra.

SECTION OF ENTOMOLOGY

President :—MOHAMAD AFZAL HUSAIN, M.A., M.Sc., F.N.I.

General

1. Amplification of the theory of multi-phased gastrulation among insects, with remarks as to its applicability to other arthropods.

M. L. ROONWAL, Pasni (Baluchistan Coast).

None of the explanations, which have been offered so far, is completely satisfactory in explaining the mode of endoderm formation in the class Insecta satisfying the general tenets of the germ layer theory. The author (*Phil. Trans. Roy. Soc. Lond.*, B., Vol. 226, 1936) proposed a theory of multi-phased gastrulation. Insect gastrulation occurs not in one or two phases, but in several. The insectan endoderm is divided into primary and secondary portions. The yolk cells are undoubtedly endodermal. The theory was first suggested in relation to *Locusta* where four gastrulation phases were recognized. The occurrence of supernumerary ventral (gastral) grooves, the yolk cell membrane, etc. present in other insects support the theory. With some amplification the theory is universally applicable to the class Insecta. Three main phases and several sub-phases of the first and second order have now been recognized. Further, not only the endoderm, but also the ectoderm and the mesoderm, are regarded as having undergone a quadruple division thus: Firstly, into primary and secondary portions; secondly, each of these become sub-divided into permanent and evanescent portions. Each gastrulation phase involves various modes for its being brought about. Of these, emboly or invagination, when it occurs, is not the most important and is a secondary feature. The insectan gastral groove is, therefore, not homologous with but analogous to the blastopore of the annelids.

There is considerable evidence which suggests that the theory of multi-phased gastrulation in its fundamental aspect, viz., the prolongation of the gastrulation act, is applicable to the Arthropoda in general and to the Myriapoda and Crustacea in particular. However, the number and nature of the various phases and sub-phases in these groups differ somewhat from those in insects. Thus, the first phase of insects is probably absent in the Crustacea.

2. Some reversal changes among locusts and other Acrididae, and the probable importance of the third instar.

M. L. ROONWAL, Pasni (Baluchistan Coast).

In the Acridiidae there is, in general, a progressive change of either increase or decrease of various characters with each instar, the direction of the change remaining constant from the first to the final instars. Recently, however, some data has accumulated which shows that, among locusts and other Acridiidae, certain peculiar changes—morphological, physiological as well as in behaviour—take place when the hoppers go from the third into the fourth instar, and in one instance, from the second into the third. These are mostly reversal changes and affect the direction of the dorsal spot of eye, the position of wing and elytron rudiments, the growth coefficients of various body parts, the respiratory intensity and, finally, the locomotor activity. Extra moulting, on the other hand, is a third instar. A partial explanation is suggested. Their biological significance, however, still remains obscure.

It is suggested that these changes are governed by an automatic regulation the mechanism of which is released, as a rule, in the later part of the third instar. Available evidence suggests there types of such regulation, viz., physiological regulation influenced by external environment, physiological regulation not so influenced and, finally, general regulation not influenced by external environment. Since the majority of these changes occur when the hopper goes from the third into the fourth instar, the third instar is considered as unusually important.

3. A preliminary note on the probable existence of seasonal migration among the solitary phase individuals of *Locusta migratoria* in North-West India.

Y. Ramachandra Rao *and* D. R. Bhatia, Karachi.

There is sufficient evidence to show that solitary individuals of *Schistocerca* are capable of making long distance migrations with the seasonal change of rain-belts, from the winter rain regions of Baluchistan to the summer rainfall areas of the Indian Desert at the beginning of summer, and at the close of summer breeding, back to the winter rain areas of Baluchistan in autumn and winter.

In the course of Desert locust survey, specimens of the solitary phase of two other locusts—*Locusta migratoria* and *Patanga succincta*—have been met with.

The analogy of *Schistocerca gregaria* suggested a similar migration in the case of these two locusts. The data available for *Patanga* are, however, too scanty for drawing any definite deductions, but in the case of *Locusta*, fairly significant, though fragmentary, information has been gathered.

It seems that the solitary individuals of *Locusta* breed in spring in Baluchistan areas and migrate at the beginning of summer into the Desert areas, where a summer generation is produced, which apparently migrates westward in autumn.

Since both *Schistocerca* and *Locusta* very often appear and disappear together in the Sind-Rajputana areas, it is presumed that the same meteorological factors—such as the development of areas of low saturation deficiency and the seasonal change in the wind-directions—affect the migration of both species.

During 1937 fairly intensive breeding of *Locusta* would appear to have occurred in the Bolan, Kohlu and other valleys of Baluchistan in May-June, and the occurrence of large concentrations of *Locusta* noticed in July at Sadulpur and Nohar in east Bikaner may possibly have to be linked with the spring breeding in Baluchistan.

4. Copulation and allied phenomena in the Desert Locust (*Schistocerca gregaria*, Forsk.).

C. B. Mathur, Lyallpur.

The behaviour of the sexually mature adults, before, during and at the end of copulation has been described. The normally very 'shy' locust is much less so when in coitus. Disturbing circumstances, such as thunder, light rain, and wind are not sufficient to force a copulating pair to break. The female, with the male on her back moves away to a place of safety.

A female plays a more or less passive part in mating, and for duration and frequency of copulation the male is entirely responsible.

The time required for the formation and transference of a spermatophore from male to female is about half an hour. A copulation of a shorter duration than this is ' false ', in the sense that the female receives no fertilizing fluid.

At the time of the first copulation the male is sexually fully mature while the female may not have reached the stage of full maturity. Mating hastens the sexual maturation of the female.

Parthenogenesis occurs, but in females which have not mated oviposition is rare and belated. Pospelov's assumption that the penetration of fertilizing fluid is necessary for sexual maturation is not well founded. Even desexualized males and females mate. A female mating with a desexualized male oviposits as early and as frequently as a female mating with a normal male.

Taxonomy

5. A proposed revision of the present taxonomy and nomenclature of the Indian honey bees.

T. V. Ramakrishan Ayyar, Madras.

Forty years have now passed since Col. Bingham published an account of the Indian wasps and bees (Hymenoptera) (Vol. I—*Fauna of British India series* 1897) and, since then our knowledge of these insects, especially regarding their classification, has undergone revolutionary change. It will be an extremely valuable contribution to Indian Entomology if a revision of Bingham's volume is undertaken. Since 1897 hundreds of new species have been recorded from different parts of India. By 1916-17 when the present writer published the ' Catalogue of new wasps and bees recorded from India since 1897 ' in the Bombay Natural History Journal, over two hundred new species had been recorded. In this paper a suggestion to revise the taxonomy of the honey bees of India is made. A proposal is put forward to erect a new Sub-genus : *Megapis* to include the rock bee—*Apis dorsata,* because it possesses striking features of its own. A proper identification of the South Indian Dammar-bee (*Melipona*) is also attempted.

6. On two Chalcidoid parasites on moths with a description of *Eupelmus terminaliæ,* sp. nov.

H. A. Hafiz, Calcutta.

The occurrence of two Chalcidoids, *Brachymeria euploeoe* (Westw.) and a new species of *Eupelmus* found as parasites of moths is recorded in this paper. A detailed description of the male and the female of the new species is also appended.

7. Some species of the Scolytidae (Coleoptera) from Mysore, with special references to the occurrence of *Stephanoderes hampei* Ferr, in dry cotton fruit stalks and carpels.

T. V. Subramanian, Bangalore.

Extensive collections of scolytid beetles were made in the coffee estates in Mysore and Coorg, when a search was instituted in 1930 for the coffee berry borer *S. hampei* Ferr. Out of the 12 different species collected four are new to science.

No *Stephanoderes hampei* was found in any of the estates. Specimens of *Stephanoderes hampei* were collected on the dry fruit stalk and empty carpels of cotton in a place far remote from the nearest coffee area.

Further examination of cotton fruit stalks and carpels from different parts of the State did not reveal the presence of the coffee berry borer

S. hampei, but all stages of three different species of the genus were obtained and these are :

Stephanaderes uniseriatus, Eggers.
Stephanaderes eupolyphagus.
Stephanaderes arecaae, Hornung.

As three different species of *Stephanoderes* are quite common on dry cotton stalks and carpels and the fourth one *S. hampei* was obtained once, it is very likely that further search will reveal the presence of this insect on this new host plant, the other host plants of the insect recorded in foreign countries being *Coffea schumanniana*, *Tephrosia*, *Crotolaria*.

Morphology

8. The mechanism of oviposition in the Ak-grasshopper (*Poecilocerus pictus*).

S. S. Kapur, Lahore.

A brief account of the morphology of the exposed parts of the ovipositor of the Ak-grasshopper (*Poecilocerus pictus*) is given. The muscles employed in the mechanism of digging and egg-laying, i.e. in *exsertion* and *retraction* of the ovipositor and *opening* and *closing* of the valulae are described.

9. On the post-embryonic development of eye-stripes and their correlation with the number of larval instars in the life-cycle of *Schistocerca gregaria* Forsk.

S. Mukerji, Karachi.

The paper embodies the observations made during the study of the post-embryonic development of stripes in the compound eyes of *Schistocerca gregaria*, and delineates its correlation with the number of larval instars in the life-cycle of this species. Thus, it has been found that 4 different types of eyes viz., with 5, 6, 7 and 8 stripes are to be recognized in *Schistocerca gregaria*, correlated as they are with 4, 5, 6 and 7 larval instars in the different types of life-cycle.

On the basis of the experimental results obtained in the case of *Schistocerca gregaria*, the author is tentatively of opinion that the same relationship exists between eye-stripes and the number of larval instars in other Acridids with difinite eye-stripes.

Further, it has been maintained that this variation in the number of instars in the life-cycle of the same species is neither a transmissible hereditary character nor is related in any way with sex, as has been considered by some authors. It has also been found to be independent of the following factors, viz. food, relative-humidity (atmospheric) and sunshine. It is suggested that the crowding of hoppers in a limited space may possibly have some effect on the inhibition of certain instars.

10. Correlation of eye-stripes, with instars of *Schistocerca gregaria* Forsk.

R. N. Batra, Sindh.

One hundred and fourteen isolated hoppers of *Schistocerca gregaria* Forsk were fed on differed food plants to discover if the number of stripes in the compound eyes of the adults could be correlated with the quality of food given to the hoppers during their post-embryonic development. The results obtained indicate that the number of eye-stripes is entirely dependent on the number of moults, a hopper undergoes during its development, but is independent of the quality of food. It is also seen that in case of seven-striped adults it is always the second moult which is repeated and that both males and females with seven stripes are produced.

11. An extra hopper stage in the Desert Locust (*Schistocerca gregaria*, Forsk.).

C. B. MATHUR, Lyallpur.

The Desert Locust usually passes through five hopper stages, not considering the vermiform larva. Sometimes an additional hopper stage occurs. This is always after the normal third stage. A hopper in extra third stage is bigger than a third stage hopper but smaller than a normal fourth stage hopper. It lies between the two normal stages in respect to the size and disposition of the wing pads, but the number of their antennal segments and the number of stripes of eyes corresponds to those of a normal fourth stage hopper. Hoppers of advanced stages and adults which have passed through the extra stage are recognizable by the additional antennal segments and eye stripe which they bear.

In a typically gregarious brood the extra stage does not occur. In the transient forms it occurs only rarely. It is characteristic of phase *solitaria* and possibly occurs to accommodate the greater growth, resulting in bigger size which *solitaria* Desert Locust attain.

12. On the thoracic mechanism of the pulse beetle *Bruchus quadrimaculatus* Fabr.

DURGADAS MUKERJI, Calcutta.

This paper is one of the series on the pulse beetle and deals with the structure of the thorax and its musculatures. The meso- and metathorax are divisible into prescutum, scutum and scutellum. The first and last constituent parts, represent pro- and mesophragmata respectively. The musculature of the wings as well as of the legs are described. The peculiarity of the flexor and extensor muscles of the wings is shown. The rotatory muscle of the third leg which shows a rotatory motion along the transverse axis is described.

13. The alimentary canal of *Coccinella septempunctata* (Coleoptera) with some observations regarding the re-association of malpighian tubules.

S. PARDHAN, Lucknow.

This paper embodies, firstly, a histological study of the alimentary cânal, specially the mid-gut of *C. septempunctata*, and secondly, a few experiments throwing considerable light on the problem of re-association of the malpighian tubules with the hind-gut.

The histological study of the mid-gut has revealed *four* definite types of epithelium one of which is surprisingly peculiar and has not been described before. This type of epithelium is peculiar in showing apparently two layers of cells one superimposed over the other, the outer layer having large, regularly arranged, inter-cellular vacuoles as have not been described before at least in the gut of insects.

In Coccinellids as well as in many other insects the malpighian tubules after originating at the junction of the mid and the hind-guts and then traversing into the body cavity re-associate with the posterior portion of the hind-gut. The significance of this re-association has remained a mystery ever since 1811 when such an arrangement was first described although several theories have been put forth, the latest of them being that of Landis (1936). The experiments described in this paper prove contrary to all previous theories, that the re-association of the malpighian tubules is a part of the device for the conservation of water. The re-associated portions of the malpighian tubules act as a filter for eliminating waste toxic material contained in the liquid which is mechanically pressed out of the colon into the body-cavity.

14. On the structure of the so-called 'penis' of the Oriental cat-flea, *Ctenocephalides felis* subsp. *orientis* (Jordan).

M. Sharif, Aligarh.

The complicated apparatus forming the so-called 'penis' of the cat-flea comprises, as in other insects, of two distinct types of structures; the phallic organs consisting of a median intromittent organ, the aedeagus and its supporting structures, and the periphallic organs which assist in copulation by clasping the female.

The phallic organs are sunk into a large genital chamber which is a permanent irreversible pit and its outer terminal portion is narrowed to form a highly sclerotized and complicated structure. The phallus is short and is about one-half the length of the genital chamber. As it cannot protrude through the narrow external opening of the genital chamber, the sperm fluid is carried into the vagina by two apodemes which in reality form the true copulatory organ. Enclosed within the dorsal portion of the periphallic organs is an elastic sac leading by a narrow canal into the terminal portion of the genital chamber, which acts as a pumping organ.

The periphallic organs consist of two strongly developed sclerites which give support to the genital chamber and the genital pouch, and the musculature of the organ. Their structure and homologies are described in detail.

Physiology

15. Effect of different sugars on the longevity of *Microbracon greeni*, Ashm.

S. N. Gupta, Namkum.

The problem was initiated by Dr. H. K. Sen, who suggested that the study of carbon assimilation might be useful in determining the conditions necessary for the healthy growth of this braconid. Arabinose (Pentose), glucose (Hexose) and canesugar (Hexodiose) were selected for study.

Arabinose 1 per cent. solution was found to be the most inferior of the three sugars. Adults fed on cane-sugar were found to live longer than those fed on other sugars. Feeding on 3 per cent. solution both in the case of glucose and cane-sugar resulted in longer longevity than on 1 per cent. solution.

16. Further observations on the rôle of blood in ovulation in Culicidæ.

S. K. Sen, Muktesar.

These observations, which are in continuation with those previously published by the author (1917, 1923), were carried out to determine the relative influence of whole (shed) blood, serum and other blood constituents on the maturation of ova in *Aëdes* (*Stegomyia*) *albopictus* Skuse. Viable eggs were deposited by these mosquitoes when they were fed either on whole blood or on serum, but their number was considerably less than in the case of those fed in the normal manner on the body of a mammalian host.

No eggs were obtained when the mosquitoes were fed on physiological (Ringer-Tyrode) saline solution or on water with a pH value approximating that of serum. The results of providing a physical stimulus in the form of liquid food heated to 37°C. were likewise negative. A proportion of the mosquitoes used in each experiment were periodically dissected out and their ovaries examined, but no indication of ovulation was obtained in individuals other than those fed on whole blood or serum.

The paper describes a convenient technique for feeding mosquitoes artificially in captivity.

Ecology

17. On some physico-chemical factors of the breeding places of *Anopheles sundaicus*.

P. SEN, Calcutta.

The paper deals with the three factors—chloride, hydrogen ion concentration and carbonates of natural waters of the Salt Lake areas to the east of Calcutta as well as in Calcutta itself in which *Anopheles sundaicus* (*ludlowii*) breeds. Only such samples in which breeding was actually going on the days of analysis were considered. It was found that the salinity as expressed in terms of chlorine varied from 634·0 to 16·0 parts per 100,000 and the average was 164·3. The variation was so great that this factor by itself cannot be utilized to predict *sundaicus* breeding areas. The pH value was more constant for the breeding water ranging between 7·7 to 8·5, the average being 8·2. The figures for carbonates were irregular and showed no relationship with pH. Presence of algæ of the genera *Enteromorpha*, *Oscillatoria*, and *Oedogonium*, as also the weed *Hydrilla* were found to be the essential factor—which factor along with pH probably determines the presence or absence of *Anopheles sundaicus* in a water collection.

18. Length of life of pink bollworm moth and its correlation with temperature and humidity.

H. D. NANGPAL *and* V. N. POORNA PREGNA, Hyderabad (Deccan).

The pink bollworm moths are relatively long lived at Parbhani. To discover the reason for this, a statistical study of the longevity of the 'short cycle' moths, in relation to temperature and humidity was undertaken. Scatter diagrams for longevity in relation to humidity, temperature, and temperature and humidity showed that the whole period—15th June to 15th April—could be divided into two separate periods: the first ending with 30th November. It was observed that the average longevity of moths in the first period was one and a half times that in the second period, and while the average daily mean temperature was practically the same for the two periods; the humidity was higher by about 50 per cent. in the first period. The coefficients of correlation were worked for all the factors and for the two different periods separately. It was found that in the first period, life was negatively correlated with temperature or humidity. In the second period the correlation was negative with temperature and positive with humidity. Multiple correlation coefficients and the corresponding regression equations for length of life in terms of humidity and temperature were also worked for the two periods. Mean humidity between 60 per cent. and 70 per cent. with mean temperature varying from 60°F. to 70°F. was found to be suitable for the long life of the moth.

19. Effect of temperature and humidity on the mortality of the silkworm, *Bombyx mori* L.

D. P. RAICHOUDHURY *and* D. C. SARKER, Calcutta.

Two generations of silkworms were reared under ordinary laboratory conditions. These were the progeny of an apparently healthy female. The first generation reared in March, 1937, behaved normally and was found to be apparently healthy. No symptoms of any disease were noticed. Neither the temperature nor the humidity was high in this month.

The second generation reared in April, 1937, was quite healthy and behaved like normal worms till the onset of the 4th moult; but after this moult, when both temperature and humidity rose fairly high, i.e. 94°F. and 87 per cent., a heavy mortality (85% approximately) occurred. Death was mostly due to Flacherie and Grasserie. This experiment confirms the view expressed by Jameson that 'When both temperature and humidity are high then Flacherie is to be expected'. Mortality ratio does not become so high by variation of a single factor.

20. Ecological study of soil organisms in the sterilized soils at Rothamstead.

K. D. BAWEJA, Lyallpur.

Soil was sterilized to a depth of one foot in February and May, 1936, by baking it at 212°F. Some plots were barricaded by iron sheets 12 inches below and 6 inches above ground and other left unenclosed. Samples were taken at fortnightly intervals throughout a sequence of 14 months. Ladell's flotation method was used for isolating soil organisms. (1) The soil organisms took seven months in the unenclosed and five months in the enclosed plots to reach normal density. At the close of the experiments the number on the sterilized plots had increased to 1·5 and 1·8 times that of control. (2) The relative proportion of the soil organisms was considerably affected. Some predominating forms having failed to maintain their dominance in the sterilized plots, some rare ones increased enormously. (3) Distinct seasonal variations were another feature of the fauna, particularly Collembola. (4) Certain injurious families of Collembola increased from 1·5 to 22 times over the control.

As the soil under tropical conditions gets partially sterilized during summer, it is quite possible that the 'Root rot' of cotton and other plants, like the 'Root rot' of sugar-cane in Louisiana, may be found to originate from the direct damage caused to the tender roots of young plants by the vast number of these small animals.

21. The influence of temperature on the rate of growth and size in the desert locust (*Schistocerca gregaria* Forsk.).

ABDUL HAQ, Lyallpur.

The rate of growth of the locust hoppers expressed as a correlation between their initial weight (at the time of hatching) and their final weight (just after acquiring wings) was studied at 27°, 33°, 37° and 40°C. respectively. It has been found to vary in inverse proportion to temperature.

Temperature also influences the size of the adult. Adults developing from the hoppers belonging to the same hatching, but bred at 27° and 40°C. showed difference in size. Individuals reared at 27°C. were bigger in size than those reared at 40°C. The locusts at the two temperatures were of the same phase (having been reared singly) but had different body proportions, suggesting that the body proportions depend on the size of the individual.

22. The effect of climatic factors on the flea *Xenopsylla cheopis*.

P. A. BUXTON, London.

Insect Behaviour

23. The frightening attitude of a desertmantid, *Eremiaphila braueri*, Kr.

M. L. ROONWAL, Pasni (Baluchistan Coast).

Eremiaphila braueri, Kr. has been observed to assume a peculiar frightening attitude when pursued by an enemy. After running away a short distance, it suddenly turns round, unfolds its wings and stands erect on its hind legs, ready to peck if the enemy approaches too close. If the enemy moves round, the mantid also moves and always tries to face his adversary. This may last for twenty minutes, or even more. This attitude perhaps frightens away the enemies which are usually lizards and probably also birds. The mantid is generally found on hard clayey and 'kallar' soils, in preference to sandy areas locally known as 'reks', and is protectively coloured, being a dull greyish brown. The lower surface of the elytra and both the surfaces of the hind-wings, which are non-functional for flight, are brightly coloured, being of a dark purple hue almost tending to black. They play an important rôle in the frightening attitude. So far, only ripe females have been observed to assume this attitude, unripe females and males not having been met with in the field. As shown by an examination of the stomach contents, the main food of the mantid appears to be desert ants.

24. Studies in the phototropic response of the larvæ of *Trogoderma khapra* Arr.

GURCHARN SINGH, Lyallpur.

Reactions of *Trogoderma khapra* larvæ to artificial light were studied. It was observed that the newly hatched larvæ showed complete indifference to light but as they grew older, they gradually developed negative phototropism, with the result that on the third day after hatching 77 per cent. of the larvæ showed distinct negative phototropism. This response became much more pronounced during the subsequent instars. A few larvæ, however, remained indifferent to light and the number of such individuals decreased markedly as the larvæ developed. Further some of the larvæ before and after a moult became indifferent to light. With the approach of the pupal instar the majority of the larvæ became indifferent once again.

Bionomics

25. Life-history and biology of *Monophlebus stebbingi*.

A. B. MISRA *and* S. R. M. RAO, Benares.

Copulation in *Monophlebus stebbingi* takes place in the third week of May, after which the females begin to retire for oviposition in suitable places and this continues till the end of July. The ovary is very rudimentary at that time and it takes five months to attain maximum development. Eggs are laid in ovisacs specially secreted for the purpose. The eggs require five to six months for incubation. The first stage nymph appears by the end of March. The sex of the nymphs can be distinguished by the colour differences the male-producing larvæ being pink coloured, the female producing ones being yellow. The nymphs of the two sexes differ in their behaviour also, inasmuch as the male nymphs retire to suitable places for the purpose of pupation, while the females remain on the branches. The duration of the second stage larvæ is 11 to 12 days. Soon after the second moult, the male nymphs lie inside the last nymphal skin and undergo a process of metamorphosis. The male moults four times, and the females three times only. The third stage of the females lasts for 16 to 18 days. The process of copulation is described.

26. On the habits and life-history of *Amphipsyche indica* Martynov. (Trichoptera).

H. A. Hafiz, Calcutta.

A short account of the life-history of a trichopteran *Amphipsyche indica* Martynov is given. The larval and pupal stages of the insect were described by the author in a recent paper, and the present account completes the account of the life-history of this form.

27. Two caterpillars of economic importance not recorded before in S. India.

T. V. Ramakrishna Ayyar, Madras.

At the previous session of the Congress the author submitted a paper on the cultivation of the Koorkan (*Coleus parviflora*), as a vegetable crop in the Malabar, and a passing reference was made to two leaf eating caterpillars causing some damage to the crop. The insects have been identified as *Pycnarmon cribrata*, F. and *Phostria piasusalis*, W.—(*Pyralidae*).

The *Pycnarmon cribrata* is badly parasitized by *Microgaster psarae* W. (Braconidae).

Observations on the bionomics of these insects have been made. There is no previous record of these insects from South India.

28. *Lithocolletis virgulata*, Meyr.

Hari Dev, Lyallpur.

Lithocolletis virgulata, Meyr., is widely distributed in the Punjab. Its caterpillar mines the leaves of *Pongammia glabra*, Vent., *Butea frondosa*, Koenig, etc.

Eggs are inserted singly, usually on the upper side of the leaf in summer and on its both sides in winter. A female lays up to 20 eggs. The eggs hatch out in 3-4 days in summer and 16–25 days in winter. The larval stage lasting for 12–14 days in summer and about 42 days in winter. Pupal stage lasts for 2 to 15 days, pupation taking place in the mine.

29. The economic rôle of South Indian horn worms (Sphingidae).

T. V. Ramakrishna Ayyar, Madras.

This paper is an attempt to bring together our knowledge of the bionomics of South Indian Sphingids of economic importance.

30. The high fecundity of the Epilachna beetles *Epilachna vigintiopunctata* Fabr, and *Epilachna dvdeeastigma* Mul., in Cochin.

C. S. Venketasubban *and* Neelakanta Iyer, Trichur.

While studying the bionomics of these two Epilachna beetles in June, July, 1933, it was found that they possessed high egg laying capacities.

Tabular details are given of the extent of oviposition of five females of *Epilachna vigintiopunctata.* It was noticed that during a period of a month and a half, they had laid a total of 1347, 720, 806, 856 and 850 eggs respectively. Breeding experiments in subsequent years with both the species, have confirmed these results.

Agricultural Entomology

31. The cotton jassid, *Empoasca devastans* distant.

M. Afzal Husain *and* K. B. Lal, Lyallpur.

Empoasca devastans is one of the most serious pests of the American cottons in the Punjab. *Hibiscus esculentus, H. vitifolius, Solanum melongina, S. tuberosum* and *Althea rosea* are its alternative hosts and are often damaged severely.

The insect breeds practically throughout the year. Eggs are laid singly, usually in the leaf veins. Nymphs moult five times before becoming adults. One life-cycle—from egg to adult, may occupy from 11 days in autumn to 32 in winter ; the adults may live for over 3 months.

Damage is caused by the immature and adult stages, which suck juice from the leaves and inject some toxic substance which kills the leaf-tissue. The leaves develop brown spots, and crinkle.

E. devastans shows considerable varietal preference and there is some evidence to show that the resistance of a variety results from inability of the female to oviposit freely on it. The rôle of some factors supposed to confer immunity from jassid attack on certain varieties, was tested. Contrary to the common belief, hairiness of leaves while being associated with resistance cannot be held by itself to be responsible for jassid resistance.

As economic and effective control is only possible through the evolution of jassid resistant varieties and a thorough study of the characters which make a cotton plant immune or resistant is needed.

32. Studies and observations on the incidence and control of *Spodoptera mauritia* (Bosid) a major pest of rice in Cochin.

C. S. Venketasubban, Trichur.

Observations on the life-history, incidence, and control of *Spodoptera mauritia*, are presented. The distribution, occurrence, and habits of the pest, in the three main seasonal crops of paddy Virippu, Mundakan and Panja including Kole—are discussed in detail. The chief environmental and climatic factors that determine an incidence, are discussed. Control measures as practiced by the local agriculturists, and those evolved by the Entomological section, are described. Dusting with calcium arsenate diluted with lime in the proportion of one to six by volume has given very promising results. The main advantage of this dusting is that it can be carried out with success in dry as well as water fields alike. The operation is best carried out, as soon as, the larvæ hatch out from the eggs.

33. Observations on the sugarcane borer incidence at the Government Sugarcane Farm, Jorhat.

K. C. Sharma, Jorhat.

The total borer incidence usually follows top shoot borer incidence. But there are exceptions in experiments in which lime and artificial fertilizers were used. In both cases top shoot borer was less prevalent.

There is a certain amount of difference in borer attack in the different varieties of canes.

There is a seasonal difference in borer attack.

In regularly attended plantations such as in an experimental farm, it may be seen that plant cane suffers more than ratoon cane from borer attack.

The cultural methods, i.e. the time of planting and also the spacing have some correlation with borer incidence.

Top shoot borer moths even in their gravid stage are more attracted by light traps than the stem borer moths.

34. *Semiothisa* (*Macaria*) *pervolgata*, a Geometrid pest of *Daincha* (*Sesbania aculeata*).

M. C. Cherian *and* B. Rangiah Pillae, Coimbatore.

A Geometrid moth—*Semiothia* (*Macaria*) pervolgata—does considerable damage to Daincha, an important green manure crop in the Madras Presidency. In 1936, a two-acre plot under this crop was completely defoliated by these caterpillars. The life-cycle of the pest occupies 17–24 days, the egg, the larval and the pupal periods being 3–4, 8–12 and 6–8 days respectively. A Braconid parasite—Apanteles sp., was noticed in numbers on the caterpillars. The remedial measures tried, include light traps, insecticidal trials, handnetting, etc.

35. Studies on *Laphygma exigua*, Hb., and its natural enemies.

M. C. Cherian *and* M. S. Kylasam, Coimbatore.

As far as the authors are aware, *Laphygma exigua*, Hb., though known to have a wide range of host plants in North and South India, has not been recorded as a pest of tobacco nurseries. The environmental conditions under which the caterpillars assume the pest form are indicated and a brief account of the nature of cultivation prevalent at Chirala and outlying parts is given.

The habits and the general bionomics of the moth and the caterpillars are given in details ; the nature and extent of damage to tobacco nurseries is indicated. A sand dune weed *Gisekia pharnaceoides*, St., has been found as an alternate host on which the pest bred both during on and off-season.

Light trapping, trap cropping with *Eleusine coracana*, spraying with lead arsenate powder and hand picking of caterpillars are some of the measures adopted by the growers.

A few experiments in control performed at Coimbatore are briefly indicated. Attempts at the utilization of the predatory Reduvid bug *Rhinocoris fuscipes*, F., and the Tachinid fly *Sturmia inconspicuoides* have shown that the former alone holds out promise.

36. Effect of bollworm attack on the number of seed, lint weight, seed weight and ginning percentage of clean locks in partially damaged bolls.

H. D. Nangpal, Hyderabad (Deccan).

The bulk of ' clean ' cotton picked from a field is generally a mixture of cotton from bolls having all locks sound and from bolls having only two or one lock sound. The cotton from bolls, with one or two locks damaged does not have the same weight as those from bolls having all locks sound. This difference is more pronounced when the bolls are attacked in their earlier stages of development. Even sound locks in such bolls are small, with fewer seeds and poor lint. The differences in the number of seed per lock, seed weight and lint weight per seed and per lock and ginning percentage of clean locks derived from bolls having one or two locks damaged and of clean locks from sound bolls have been studied. In addition to this the locks from bulk clean cotton and total saleable cotton have been compared with clean locks from sound bolls. It has been determined that the locks from sound bolls have more seed per lock, have more seed weight and lint weight, and give a higher ginning percentage than the locks from damaged bolls. The loss in the crop due to bollworm attack when calculated on the basis of clean locks derived from sound bolls is always higher than the one calculated on the basis of total clean locks (bulk) from a plot.

37. Incidence of spotted bollworm attack on cotton at Parbhani (Hyderabad-Dn).

H. D. Nangpal, N. T. Nadkarni, *and* T. E. Krishnaswami, Hyderabad (Deccan).

Two different species of the spotted bollworms—*Erias fabia* Stol and *Erias insulana* Bosid—damage the cotton crop in Hyderabad-Dn. The former is more common and is met with throughout the period the cotton plants stand in the field, while the latter is present in some numbers in the beginning and towards the end of the season. Their incidence on the crop is greatest during which period most of the damage to the green forms is done. In a bad year as many as twenty-five per cent., of the buds and about forty per cent., of the bolls are found to be attacked by spotted bollworms. Most of the attacked forms get shed and bollworms are responsible for more than fifty per cent. of the shed forms. After about the first week of December their activity declines and the percentage of incidence is lessened. Once again towards the end of February a slight gradual increase in the percentage of forms damaged by spotted bollworms is noticed.

38. A caterpillar pest of champaka (Michelia) in South Malabar district.

T. V. Ramakrishna Ayyar, Madras.

The champaka (*Michelia Champaka*), apart from its value as a timber tree, is ever green, and its sweet smelling and beautiful golden flowers command a good market in all villages and towns. It thrives along the foot-hills and uplands of the Western Ghats and is commonly cultivated round about temples, being one of the trees held in some veneration by Hindus, in many localities. The writer has on his farm, in the South Malabar district, a few young champaka trees and recently these were attacked by the leaf-eating caterpillar of *P. agamemnon* (Papilionidae). The bionomics of this insect is presented.

39. A new *Cecidomyiad* pest of Moringa.

M. C. Cherian *and* Mohamed Basheer, Coimbatore.

A study of the fauna of the flower buds of *Moringa pterygosperma* has revealed the presence of different insects such as Cecidomyiads, Pyralids, Thrips, Braconids and Chalcids. Of these, the first one, noted as a pest of moringa buds was described as a new species by M. S. Mani of the Indian Museum, Calcutta. A short account of the bionomics and natural enemies of this insect is presented. Control measures tried against the pest are also briefly indicated.

40. The amaranthus stem weevil of S. India (*Lixus brachyrrhinus* Boh.) and its parasites.

P. N. Krishna Ayyar, Coimbatore.

In an attempt to evolve a system of biological control of the cotton stem weevil (*Pempheres affinis* Fst.) one of the difficulties experienced was the scarcity of the host during the greater part of the year for the artificial multiplication of the parasite. A subsidiary host was found in the common amaranthus stem weevil (*Lixus brachyrrhinus* Boh.). It is easily available and regularly abundant and has yielded satisfactory results for maintaining a stock of a few of the more important parasites of Pempheres, although not for their rapid multiplication. This useful laboratory host is of a further interest as it harbours a relatively rich series of parasites, some of which may be expected to transfer their attention to the cotton stem weevil.

The bionomics of *Lixus brachyrrhinus* has been studied.

About eleven species of Hymenopterous parasites—seven chalcidoids and four braconids—have been bred out of the immature stages of the weevil. Among these *Tetrastichus dinarmus* and *Spathius* constitute the more important ones. All the parasites are ectophagous with the exception of *Tetrastichus* sp. which is an internal feeder. An undetermined chalcidoid is an egg parasite.

Observations of the life-histories of many of these have been made.

41. Measures against sugarcane pests in the Jullundur circle.

M. Fateh-ud-Din *and* Bh. Dalbir Singh, Jullundur.

There is rapid increase in the cultivation of improved cane and in one locality the area under Coimbatore types has risen from 15,670 acres in 1929-30 to 95,831 acres in 1936-37. But the top-borer and pyrilla are the serious limiting factors in the spread of high yielding canes. During 1934-35, the top-borer attacked, on an avarage 60 per cent. of the shoots; and pyrilla damaged the crop so badly that cane tops were even refused by cattle and gur of very poor quality could be obtained. Because of low recovery of sugar from the pest affected cane, the Jagatjit Sugar Mills, Phagwara, had reduced the price of cane to 2·5 annas per maund, and the growers preferred to sell their cane even at this low rate.

Regular campaigns against sugarcane top-borer and pyrilla by simple methods have been conducted in compact blocks of several villages. Two years' results are available.

Hand-picking of moths and egg-clusters of the top-borer and the removal of borer-affected shoots, reduced the top-borer attack in the treated areas from 3 to 5 per cent. as against 30 to 40 per cent. in the untreated localities.

Hand-netting of pyrilla adults early in the season and crushing the egg-clusters simultaneously gave very satisfactory results.

The total cost of all these control operations, by engaging hired labour was Rs.3-12 per acre. In the case of ordinary peasants who attended to these simple operations themselves the cost was nothing and crop remained healthy.

Horticultural Entomology

42. An annotated conspectus of the insects affecting fruit crops in South India.

T. V. Ramakrishna Ayyar, Madras.

Among the problems which face a fruit grower the insect problem is perhaps the most important. Information on the entomological aspect of fruit growing in S. India, is presented.

43. Some observations on the bionomics and control of fruit fly pests in the N.-W. Frontier Province.

H. S. PRUTHI *and* H. L. BHATIA, New Delhi.

The fruit flies are of importance in almost all fruit growing tracts of India. Pears, peaches, loqats, guavas, apples, mangoes, etc. all suffer from the ravages of these flies. Observations have been made on the biology and life-history of these pests in the North-West Frontier Province, where pears and peaches suffer most badly. A number of sprays, baits, and repellant has been tried, the result of which are briefly summarized.

44. On *Agrilus citri* Thery (Buprestidae), a pest of *Citrus acida* in Bihar.

B. B. BOSE, New Delhi.

The buprestid grubs which are popularly known as flat-headed borers feed on the sapwood just beneath the bark of the host trees, sometimes killing them outright.

The genus *Agrilus* is very large and contains nearly 1,100 species, of which 38 occur in India.

Agrilus citri Thery is being recorded from India for the first time. It was obtained from a tree of *Citrus acida* at Pusa which was killed by the ravages of its grubs. A seedling of this which had been planted in the compound of the Insectary at Pusa in 1926 and which up to 1933 gave good size fruits in large numbers was found in June 1934 to be suddenly dying away and its leaves had turned yellow. On examination grubs, pupae and beetles of *Agrilus citri* were found in its trunk and branches. The nature of damage by the grubs has been described.

This pest was found to be parasitized in the grub stage by the braconid parasite.

The various stages in the life-history of the pest and its parasite *Spathius* sp. have been described and illustrated. The parasite has not yet been identified specifically and is new to the collection of the British Museum (Natural History), London.

45. Studies on the coconut beetle (*Oryctes rhinoceros*, Linn.) in South India.

M. C. CHERIAN *and* K. P. ANANTANARAYANAN, Coimbatore.

The palm beetle (Oryctes rhinoceros, Linn.) has long been recognized as one of the major pests of the coconut palms in South India. As supplementing work already carried out in the past on the subject, the present paper deals mainly with the observations made at Coimbatore, during the past two years, with regard to (1) life-history, (2) habits of the larval and adult stages, (3) nature and extent of damage, (4) seasonal incidence and breeding activity in the field, and (5) the control methods tried. The paper includes also some interesting observations on the activity and breeding of the beetle in captivity.

46. Preliminary studies on the biology of the mite (*Tetranychus* sp.).

A. N. SAPRA, Lyallpur.

This species is a serious pest of cucurbits especially ' tindas ' (*Citrullus vulgaris* var. *fistulosis*). It has been collected from sixty different plants at Lyallpur, but tomatoes, pulses, beans and cabbages are more seriously infested.

There are five stages in the life cycle of a female and only four in that of a male, one of the nymphal stages being absent. Parthenogenesis is common and the parthenogenetically laid eggs produce males only.

This mite becomes active in March and by the end of April it is present on most of its food plants. This activity is maintained till July, when monsoon rains kill all stages except the eggs which carry on the infection. During September and October all stages of the pest are present. By the middle of December only gravid females remain which over winter.

A male dies within 48 hours after copulation but lives for 5–8 days if unmated. The female lives for 8–12 days during which period it lays 32–93 eggs at the rate of 4–15 per day. The incubation period and the duration of immature stages during April–September, is 3–5 and 2–4 days; and reach the maximum of 30 and 27–33 days respectively in December to January.

Parasites of Insects

47. Mass breeding of *Microbracon greeni*, Ashm.—an ectoparasite of the larva of *Eublemma amabilis* Moore, predaceous on lac.

S. N. Gupta, Namkum.

Successful biological control of an insect necessitates easy and efficient breeding of the parasite, determination of correct concentration of host and parasite, period of their contact, stages of liberations and efficient methods of transport and liberation.

The paper describes the evolution of a most convenient and effective oviposition case consisting of a round 12″×4½″ culture jar and breeding devices leading to breeding in lac domes. The most suitable contact period of parasite and host was 3–4 days in summer, 3–5 days in autumn and 4–6 days in winter. The best concentration of parasite and host, in the cage of above size, was 10 male and 20 female parasites to 40 host larvæ. Breeding eggs or larvæ of about the same age reduces cannibalism, etc. and increases the effective rate of breeding. Use of lac domes and spinning disc in breeding was found superior to breeding in glass blocks.

The most convenient stage to transport the braconid parasite, either for liberation in fields or to out stations for breeding is the cocoon stage. This is best done either by allowing the parasite to pupate in specially evolved spinning discs described in the paper, or in lac domes. These are to be kept in pockets of 20 mesh iron wove wire net.

The method has proved effective in breeding *Microbracon hebetor*, *Aphrastobracon flavipennis*, *Elasmus claripennis* and *Cedria paradoxa*. The points essential to success of mass breeding are: adequate supply of air, space, reflected light of moderate intensity and fresh food in oviposition cages. Excessive draught, humidity and hiding places in the oviposition cage should be avoided. Cleanliness of the cage and vessels used, prompt removal of dead parasites and protection against ants are necessary.

48. A preliminary note on the bionomics and mass-breeding of *Trichogramma* sp.

A. G. Hussain, Lahore.

Two species of *Trichogramma* parasitize *Argyria sticticraspis* and *Chilo zonellus*. These parasites have been bred on eggs of different insects. The duration of life-cycle varies with the hosts, from five to seven days. Further the duration of the life-cycle and longevity of the adult life varies with temperature. The optimum range of temperature and humidity is 25°C. to 30°C. and 70 per cent. to 100 per cent. respectively.

No polyembryony has been noticed, but more than one egg may be laid in the same host egg.

The size of the individual varies with the number of parasites developing in the same host egg. The developing larvæ of the parasites get food by producing a current of food particles within the host egg.

For mass breeding, it is necessary to get a suitable host which can breed throughout the year and can lay a large number of eggs. *Sitotroga cereallela* has been successfully bred and a special apparatus has been designed to collect moths and their eggs in large numbers.

49. A trachogrammid chalcid parasite of the egg of *Eublemma amabilis*, Moore, predaceous on lac.

J. N. SINGH, P. S. NEGI, M. P. MISRA, *and* S. N. GUPTA, Namkum.

It is the first time that an egg parasite of one of the enemies of the lac insect has been discovered. The parasite is of great economic importance, as it will control the lac predator *E. amabilis*—which is responsible for 33 per cent. damage to lac crop—before it has done any damage. Its value in biological control is further enhanced by the fact that it also reproduces asexually.

Tentatively it has been placed under the genus *Pentarthron* family *Trachogramminidae*.

The male and female chalcid, the female pupa have been described. Mating and oviposition have been studied. The egg and the larval period in July-August is 5 days and pupal period 4-5 days. The maximum longevity of female was 6 days and average 2·4 days. On experimental basis 8 females parasitized 4·9 per cent. of 349 eggs offered to them; 88 per cent. of the eggs laid developed into adult. In the field under natural conditions out of 2,898 *E. amabilis* eggs, on 1,327 inches of Ber (*Z. Jujbua*) lac stick, 3·8 per cent. were definitely found parasitized by this chalcid.

With the development of proper breeding technique and host and parasite concentration the chalcid is evidently destined to revolutionize lac cultivation.

50. *Apanteles tachardiae* Cam. and endoparasite of the larva of *Holcocera pulverea*, Meyr., predaceous on lac.

M. P. MISRA, S. N. GUPTA, *and* J. N. SINGH, Namkum.

The paper describes the mating and oviposition habits of *A. tachardiae*. In the laboratory the female allows the male to mate if starved from 5–8 hours. The longevity and the life history stages of the parasite are described in brief. The minimum and maximum life history period of males and females was 11 and 42 and 12 and 44 days respectively. The life-history and the number of generations during the year are discussed. There appear to be fifteen generations when pre-oviposition period is added to the average monthly life-cylce periods, but if the pre-oviposition is excluded the generations increase by two more. The relative prevalence of the parasite in various crops has been found to be in about the same proportion as that of the host. Parasitization of the host is more in *Katki* and *Aghani* than in *Baisakhi* and *Jethwi* crops.

51. *Pareuderus torymoides* Ferr, an egg parasite of the Amaranthus borer *Lixus truncatulus*.

TASKHIR AHMAD, New Delhi.

The life-history and habits of *Lixus truncatulus* a pest of cultivated and wild Amaranthus were reported by the writer last year (*Proc. 24th*

Ind. Sci. Congress, 1937). The eggs of this weevil which are laid inside the tissue of the host plant were found parasitized by a chalcid parasite, *Pareuderus torymoides* Ferr. This parasite is recorded from India for the first time.

The parasite lays a single egg on the host egg. On hatching the young parasite grub punctures the host egg and feeds on it. Its larval life is completed on a single egg and when full grown it pupates in the same cavity.

At 27°C. the egg stage lasts about one day, the larval stage 5-6 days, and the pupal stage about 5 days. Thus one generation of the parasite is completed in about 12 days as against roughly 2 months required by the host. It develops comparatively much more quickly and thus exercises considerable check on the multiplication of the weevil. The anatomy of different stages in the life-history of the parasite is described and illustrated.

52. A chalcid parasite of the linseed midge, *Dasyneura lini.*

TASKHIR AHMAD, New Delhi.

Dasyneura lini Barnes has recently been reported as a new pest of linseed by Pruthi and Bhatia (*Proc. 24th Ind. Sci. Congress,* 1937). This pest is found on *Cajanus indicus* also, and is widely distributed in North India.

During the spring of 1937 while this pest was being studied at Karnal, Punjab, it was discovered that its larvæ were attacked by an important chalcid parasite which is yet awaiting identification. The bionomics of the parasite is described in the present paper.

The parasite lays its eggs singly inside the crumpled buds of linseed harbouring almost full grown host larvæ. The eggs hatch in 2-3 days at 13°C., and in 3-4 days in the field during February. The eggs are not laid on the body of the host, therefore, the young grub on hatching wanders about in the bud in search of the host. It is fairly hard and can stand starvation for about 24 hours. In order to complete its larval stage the grub requires 2-3 host larvæ and this number is usually always found in affected buds. At 18°C. the grub pupates after 12-15 days within the bud and the adult emerges after another 11–13 days. Thus under these conditions one brood is completed in a little less than a month. During February it was estimated that roughly 50% of the full grown host larvæ were being killed by the parasite grubs.

53. Notes on a braconid parasite of the wax moth (*Galleria mellonella*).

M. C. CHERIAN *and* S. RAMACHANDRAN, Coimbatore.

A braconid parasite was noted for the first time in South India on the wax moth—*Galleria mellonella,* a serious enemy of the honey bees. An attempt was made to study the life-history and habits of the parasite to see whether the results obtained would throw some light on the possibilities of biological control of the pest. Information on the parasites is given under the following heads :—description of the adult, life-history, parthenogenesis, longevity, seasonal incidence, other hosts and status of the pest.

54. *Rhaconotus scirpophaga,* a parasite of the sugarcane white moth borer (Scirpophaga).

M. C. CHERIAN *and* M. ISRAEL, Coimbatore.

As a result of the intensive study of the natural enemies of *Scirpophaga* in Coimbatore seven larval parasites have been collected. A paper on

Stenobracon nicevillei was submitted to the Indian Science Congress. 1936; another one on *Elasmus zenhtneri* has been sent to the Madras Agricultural Journal for publications; *Rhaconotus scirpophaga*, yet another parasite, is the subject matter of the present paper. Interesting information on the habits and life-history of the parasite, egg-laying capacity, longevity, etc. is given and the status of the parasite discussed.

55. The bacterial flora in the gut of the larvæ of the cocoa moth, *Ephestia elutella* Hb.

S. E. Jacobs *and* D. P. Raichoudhury, Calcutta.

Ephestia elutella larvæ have been shown to harbour a streptococcus in their intestines. The organism occurred in large numbers only when food had been recently ingested. It rapidly died out when food was withheld, and was absent from hibernating larvæ. The organism was described and shown to produce acids from carbohydrates. It was very sensitive to these acids, and died out fairly rapidly in such cultures. The organism cannot hydrolyse starch, and must depend for its nourishment on a diastase secreted by the larvæ, whereby sugars useable by the streptococcus are produced. The presence of the organism in the food led to its appearance in the intestines. The organism was not essential to the proper development of the larvæ. The possibility of the organism having some adverse effect on the larvæ is briefly discussed.

Insect Vectors

56. The cotton white-fly as a vector of the leaf curl disease of tobacco.

H. Singh Pruthi, New Delhi.

Tobacco suffers from leaf curl or crinkle in several parts of the world, e.g. East Africa, Rhodesia, India, Java, etc. In India the disease is most common in the Gangetic delta region, especially Bihar, where sometimes 60–70% of the plants are affected. As the value of tobacco crop is almost wholly dependent on the nature and texture of its leaves, the economic loss due to this disease can be easily imagined.

The disease belongs to the virus group. Most virus diseases are known to be transmitted by insects. Observations on the disease have been taken and a large series of transmission experiments performed at Pusa during the last three years. They are very briefly reviewed in the present paper. The work indicates that *Bemisia gossypiperda*, M and L—the common white-fly of cotton is the most important transmitter of disease, from diseased to healthy tobacco. Some alternate hosts of the disease have been discovered and in their case also the white-fly has been found to be capable of carrying the disease from diseased plants to healthy plants of the same species as well as to tobacco.

The technique followed in transmission experiments is described in detail.

Statistical

57. The relative efficiency of some methods for comparing jassid population in cotton fields.

K. B. Lal, New Delhi.

Empoasca devastans Distant, which mainly infests the American cottons in the Punjab, shows considerable varietal preference. To measure the incidence of this pest in different plots it is necessary to determine the density of population. Four methods have been tried.

1. Collecting adults by sweeping with a net and counting them.
2. Killing nymphs and adults on a plant by fumigating and determining the population.
3. Removing leaves from a plant and calculating the number of nymphs per unit area of leaf surface.
4. Counting adults and nymphs in the field by examining individual plants.

The data obtained have been examined by the method of analyses of variance. The first method is sufficient for comparing the numbers of adults jassids in adjacent plots but fails if the plots are at some distance apart. The second method is satisfactory for adults but not for nymphs. A pretty accurate nymphal population is given by the third method and the fourth is more satisfactory (for nymphs only) if a certain degree of intelligence is assumed on the part of the observers.

In view of the fact that jassid attack is not uniform in cotton fields, the accuracy of population estimations of this insect would depend on a large number of small samples drawn from all parts of the field.

* * *

SECTION OF ANTHROPOLOGY

President:—B. S. GUHA, M.A., Ph.D., F.N.I.

1. A plea for a new outlook in Anthropology.

S. C. ROY, Ranchi.

In this paper the author pleads for greater attention than has been hitherto paid by Indian anthropologists to the psychological and spiritual (in the widest connotation of the term) side of human society and its growth, than to the physical side of man and the technical side of human culture. Not that the study of these latter aspects is to be neglected, but the students' interest in them, should, the author thinks, be subordinate and ancillary to his interest in the former.

As the cultural and spiritual side of man constitutes the real essence of humanity and distinguishes Man from the rest of the animal creation, it is fitting and proper that in India at any rate, the science of Man should be classed apart from Zoology and not as part of it, as the National Institute of Sciences of India has thought fit to class it. The author has pleaded for this line of approach on some previous occasions, but he thinks it will bear repetition as it requires to be stressed.

2. In how far national or racial cultures are distinct from one another.

J. F. BULSARA, Bombay.

People speak and write vaguely about 'Western Civilization' and contrast it with the 'Oriental', and some speak equally ambiguously of 'Western Materialism' and 'Eastern Spiritualism'. Some also speak of the distinctive cultures and cultural complexes of various lands or peoples, e.g. of the Japanese Spirit, Chinese Civilization, German Kultur and Aryan Origins. To understand this alleged difference of cultures of two arbitrarily demarcated areas of the globe, or of various races or peoples, we have to enter into a deeper analysis of the factors that constitute culture and civilization and view them in relation to the peoples or races that have evolved them. Some of these factors are superficial and some essential, such as clothing, manners, etc. on the one hand, and social and political organizations, etc. on the other.

It may be found that in the superficials of culture there is an apparent wider divergence, while in social organization, status of sexes, individuals and classes also, there are differences, but in the more essential factors of social justice, spiritual values and aims and objectives of life, the difference between the so-called Oriental and Western civilizations is not so great. Besides, it is difficult to demarcate geographically, racially or even nationally the areas or peoples who are Eastern in their entire outlook and contents of culture, or are entirely Western.

One great factor that emerges from a deeper analysis is the gradual modernization (i.e. the acceptance of ideas that make for efficiency) of the peoples of the world, and also that the ultimate higher values of civilization are getting to be common to all peoples of the world, though some nations may be accepting and assimilating them quickly while others may be doing so more gradually and haltingly. Whether all races of mankind can in a given period of time and under favourable conditions, assimilate the ultimate higher values of civilization equally with the so-called civilized ones, is a problem worthy of closer scientific investigation.

3. The crisis in modern Anthropology.

BARON VON EICKSTEDT, *Breslau.*

This lecture wants to show the development of the different trends in Anthropology in various ages and countries and their connection with the main mental situations and movements. Anthropology is taken here only in the meaning of biological research in anthropos himself, the only real science of man, races and humanity. A critical observation of the historical development of its notions and methods reveals at once certain logical contradictions and a number of vague applications. They are the real reasons for the present critical situation in Anthropology which has the possibility of enormous progress and therefore an enormous spreading of misunderstandings also. The way out of these difficulties is shown by modern holistic anthropology with its logical frame and scientific biological basis.

4. The significance of cowrie shells in Khasi ceremonies.

DAVID ROY, Shillong.

At the crossing of three roads a cowrie shell is thrown on the ground and the name of the person who died far away in foreign lands is called, and the shell is brought home on a piece of white cloth. This shell is placed with the bones and ashes of those who died at home ; these remains of the dead are interred in the family tomb stone—the dolmen which is the ' Mawbah ' of the family. The significance of this ceremony with the cowrie shell in Khasi life is simple and clear, and no one can dispute the sanctity of its purpose. The dead, the irrecoverable remains of the dead, are brought and made immortal in the cowrie shell and the full person of the dead is there in its entirety.

The use of shells by the Khasis in invoking the spirit of the departed and bringing back that spirit to life seems to signify that the shell is endowed with the power of the giver of life which it simulates.

Khasis have an intimate knowledge of the anatomy of the human body and the functions of the various organs. They know that life in its embryonic stage was formed in the uterus, and it is associated with the opening of the portal of life, by which we all enter the world. Perry says that the cowrie shell, as the symbol of fertility and birth, has always been closely associated with women. It was the symbol of maternity. Khasis say, from woman springs the kind ' Da ka kynthei iong jaid ', and speak of man as the giver of the seed, ' U Kpa uba ai ia ka rynieng [lit. the father who gives the stature (person)].

In the plants and the seed that they put down to grow they notice that plant life cannot thrive without water and so, as Khasis got from the food collection to the food productions stage, they must have realized the part played by water in the production of life. Thus the cowrie is thrown on the ground and rice is scattered on it and water is sprinkled and the name of the deceased is called. The person of the dead in the halo of its sacredness is represented in the bones and ashes of the dead, and these remains are brought with ceremonial performances to the family dolmen, Mawshieng. In case these remains could not be obtained, the cowrie shell, the rice and the water are used to call back the person, Rngiw ; and this Rngiw in the shell represents the thing in which his person can permeate. Thus Khasis call back the *Rngiw*, and that spirit from the regions unseen by the naked eye to a static life of continued existence in a world of fuller realization of the home of true kinship. Man in his *Rngiw* is immortal; this Rngiw is born of God and it is supported in life by feeding the physical in man, and is revived again by the water of life. The dead, the irrecoverable remains of the dead one, are brought and made immortal in the cowrie shell; and the full person of the dead, the Rngiw and its spirit are there in their entireties.

5. Considerations concerning the Ethnology and Early History of the countries bordering on Tibet.

F. W. THOMAS, Oxford.

6. The coining technique of the Yaudheyas.

B. SAHNI, Lucknow.

While several coins of the Yaudheya republics have been known to numismatists for some considerable time, our knowledge of the technique employed in their making is extremely meagre; and so far as I am aware, no records exist of the mints from where they were issued.

In 1936 (Current Science, 4: 796–801) the author briefly announced the discovery, among other relics, of the site of an ancient mint of the Yaudheyas (*ca.* 100 B.C.) in the Khokra Kot mound at Rohtak, about 40 miles west of Delhi. Two visits were paid to the site in 1936, and several thousands of coin moulds were recovered from a level about 3 feet below the surface. In March, 1937. I showed the site to Mr. K. N. Dikshit, Director General of Archæology, and a few more fragments of moulds were collected.

The main object of the present communication is to describe in some detail the coining technique which was briefly indicated in the preliminary note. Incidentally the archæological importance of the Khokra Kot mound is stressed. As suggested in 1936, a systematic excavation of the earlier strata holds out a promise that here we may be able to narrow down, if not completely bridge, the great gap in our knowledge between the 'prehistoric' period of the Indus civilization, and the historic period, which at present is known to extend back only to a few hundred years B.C. It is gratifying to know that the Director General has agreed to have the mound excavated. Possibly it will prove to be one of the few sites in India which have been in occupation, off and on, since the Harappa times; the modern city of Rohtak stands on the southern portion of the mound.

7. The Nal pottery.

N. G. MAJUMDAR, Calcutta.

In 1903, a number of polychrome vases bearing geometric patterns were discovered by Mirza Sher Muhammad in the Sohr Damb mound at Nal in the Kalat State of Baluchistan and subsequently sent to the McMahon Museum at Quetta. An account of it was published by Sir John Marshall in the Annual Report of the Archæological Survey of India for 1904-05. In 1925, Mr. Hargreaves of the Archæological Survey was deputed to Nal for a systematic exploration of the site. This resulted in the discovery of prehistoric burials, and from them were recovered further examples of the same polychrome pottery. Since then, it has received further attention from scholars in connection with the discoveries at Mohenjodaro and other sites of the Indus Valley.

During the author's explorations in Western Sind in 1929-30 and 1930-31, polychrome vases with geometric patterns, which recall to some extent the Nal examples, were excavated at a number of sites. This has now necessitated a fresh study of the Nal pottery. A major part of the Quetta collection of this pottery has now been transferred to the Indian Museum, Calcutta, after the destruction of the McMahon Museum in the recent earthquake. In the present article, an attempt has been made to indicate tentatively the position in order of sequence of this pottery, and also of the kindred wares from Sind and Baluchistan. It has also been suggested that to obtain a more definite idea of their sequence, further excavations and researches in this terrain are necessary.

8. Further discoveries of Palæolithic cultures in the North-West Punjab.

D. Sen, Calcutta.

In this paper the author first outlines the prehistoric geology of the north-west Punjab, and then gives a typological estimate of the palæolithic cultures found in course of his tour. He has particularly dealt with the lower palæolithic cultures, which are essentially composed of a coup-de-poing industry represented by a variety of forms from primitive to more evolved types. The author thinks that a core-tool-people may have been the early settlers in the plains of the Punjab, having emerged during the closing stages of the Siwalik history, and initiated the pebble or core culture with coup-de-poing as their type tool par excellence. The flake cultures are also typologically determined. They had a more or less parallel evolution within the core-tool-civilization of the lower palæolithic period, but developed and established as a distinct culture in the middle palæolithic period.

9. Height and Cephalic index of the Bengali students.

A. N. Chatterjee, Calcutta.

Introduction—Conclusions based on examination of 9,240 University students above 18 years of age in the following proportions: Brahmins—3,017, Vaidyas—716, Kayasthas—2,499, other Hindu castes—2,097, Mohammedans—919—Av., S.D., and percentage distribution of height and cephalic index in the different classes tabulated district by district (25 tables).

Class differences:—The differences among the different classes in the same district are extremely small—Brahmins show a tendency to tallness,—the Mohammedans a tendency to shortness—distribution of cephalic index variable—peculiarities of distribution pointed out.

Effect of urbanization—extent of Brachycephaly among the Brahmins and the Kayasthas.

Variations in districts studied from 10 district maps of Bengal showing distributions of criteria—trends and tendencies—correlation of height and cephalic index.

The following areas distinguished:—

(*a*) of Brachycephaly with tallness in South-Central Bengal,
(*b*) of decreasing Brachycephaly with tallness in West-Central Bengal.
(*c*) of increasing Dolichocephaly with shortness in—(i) South-West Bengal, (ii) North Bengal, (iii) South-East Bengal.

Conclusions.

10. Anthropological research in Southern India.

Lidio Cipriani, Florence.

In 1934-35, the author carried out anthropological and ethnological investigations in Southern India and Ceylon, particularly in Coorg, Cochin and Travancore. He took anthropometric measurements on 2,323 individuals belonging to 36 castes or groups and collected many samples of hair, numerous ethnographic objects, etc. He has analyzed the somatic features of the Coorgs, Yeruvas and Kurumbas, male and female and has compared them with the Kadirs, Kanikkars and Uralis.

11. The Radhiya and the Varendra Brahmans of Bengal.

T. C. Ray Choudhury, Calcutta.

The author discusses the relationship of the two—based on the somatometric measurements and physical observations and thinks that both may be considered as members of the same racial group. Both of them are again compared with the Kanaujiya Brahmans and are found to be distinguished from them in important physical characters.

12. The functions of Physical Anthropology.

R. A. Fisher, London.

(In collaboration with the Statistical Conference.)

13. Indian oil presses.

K. P. Chattopadhaya, Calcutta.

In an earlier paper, the writer pointed out that primitive oil press is found in Nepal, in association with an early culture in that area. The early culture was characterized by certain special features, which revealed that it reached Nepal from India, prior to the incoming of Vedic Indo-Aryans.

The oil press consists of two planks, generally a log sawn in two, fixed to an upright post at one end. The oil seed is introduced between the logs and then pressure is applied by means of a lever. The oil press is found in Nepal and Assam among non-primitive social groups ; and in Chota Nagpur, Central Provinces and Madras among primitive tribes. A cruder form of the press is found in Assam and also in the Nicobar Islands.

The different types of oil-mills in India are then described. The South Indian mill has a stone mortar. In Bengal and Gujrat, the oil-mill has a wooden mortar. But it is often without a hole. Elsewhere, in North India, the mortar has a hole to drain the oil. The terms applied to the mill and certain subcastes in different areas also show some peculiarities. With the exception of the *Tili* in Bengal, the oilmen are generally regarded as impure, except in Nepal and Assam.

The possible origin of oil making by boiling, among a hunting and fishing people is discussed. The possible development of the oil press—by way of the tree-press of Assam and Nicobar—is then indicated. The invention of the oil-mill, following the line of development of a rotary quern from handmills, is next considered.

The writer concludes that the earlier form of the oil-mill in India is the South Indian type with its stone mortar. It has spread from this area to North India.

14. Polyandry in Kota society.

David G. Mandelbaum, Ootacamund.

While a woman may have but one legal spouse, the brothers of the husband have sexual access to her and act as secondary husbands. This fraternal polyandry is founded on a functional principle which pervades other aspects of the culture, the principle of the equivalence of brothers. A set of brothers share equally in economic and personal life as well as in the marital sphere. Classificatory brothers and real brothers have uniform rights where non-material phenomena are concerned, but in regard to tangibles, uterine brothers take precedence. When the fraternal principle comes into conflict with another of the major themes of the culture, it is sometimes cancelled, sometimes dominant, depending on its effective rating in the particular situation. Intrafraternal jealousy is sternly quelled, but the numerous and violent quarrels between brothers about property may be the reverberations of repressed sexual hostility. Despite the inroads of foreign traits, the fraternal principle is still economically valid. Hence polyandry still flourishes.

15. Clan-monopoly of personal names among the Purum Kukis.

T. C. Das, Calcutta.

Among the Purums—an Old Kuki tribe of Manipur in Assam—each clan exercises monopoly right over a number of personal names. The members of the clan are required to select names from amongst this group. Infringement of this rule is punished with a pig and a pot of *Zu* (rice-beer). In the earlier days each clan had a number of fixed names handed down from generation to generation, but at present the number has increased and new names have been added. The clans too have extended monopolistic right over these new names.

16. Kinship and marriage among the Coorgs.

M. B. Emeneau, Ootacamund.

The Coorgs are organized in exogamous patrilineal sibs. A woman on marriage takes her husband's sib-name, and by a contract which forms part of the wedding ceremony gains right in his sib and loses effective membership in her father's sib. She may regain membership in her father's sib if divorced, and this may happen only if the consent of her father's sib is obtained. A ceremony corresponding to that at marriage must take place in which she renounces membership in her husband's sib. A similar ceremony takes place if, when widowed, she marries a man who does not belong to her first husband's sib. Details of the marriage ceremonies are described. One detail shows clearly that cross-cousin marriage, which is common at present, is regarded as preferable. Cross-cousin marriage is of the symmetrical variety. The kinship terms used by the Coorgs are given and discussed.

17. On the Anthropology of the Todas.

Lidio Cipriani, Florence.

119 Todas, 61 males and 58 females, were measured by the author at Ootacamund (Nilgiris) in 1935. In his analysis he has considered several combinations of characters together. The two sexes show differences in characters both qualitative and quantitative, and the author concludes that in the small series, there is a certain Australoid affinity as indicated by tall stature with arms rather short or medium and a short bust; and the women show some negroid features as shown by rather high stature, long arms and short bust. The women also show a larger percentage of dark eyes. The Todas are not therefore a pure type, segregated and unchanged but they have been immune from any recent admixture such as that from the Dinaric type of Coorg.

18. Racial analysis.

H. J. Fleure, Manchester.

In analyzing physical characteristics of men we have to remember that almost every population includes contributions from several in-drifts that do not completely blend.

Homo sapiens, with contributions to his characteristics from diverse hominids in various areas, developed his main characteristics in the area of distribution of Chelleo-Acheulian, Aurignacian and Capsian cultures under temperate conditions, probably in N. Africa and S.W. Asia, including early extensions to India. Principal drifts probably include :—

(*a*) a drift S. and S.E. from the zone above-named, characterized by a short head of breadth 140–145 mm., and cephalic index therefore 80 ±, nose broad and short, mouth prominent, hair kinky, eyes prominent, stature short, frequent steatopygy in women ;

(*b*) a drift chiefly S. and S.E. but also N.W. and eventually N.E. with very long head of breadth 140 ± mm., and thus very low cephalic index (usually 73·5 or less), strong brow ridges and cheek bones in most cases, hair fundamentally wavy, but, when these characters spread into regions with kinky hair, they may take on this character probably by intermixture. Stature moderate. Skeletal characters to some extent like those of Aurignacian men ;

(*c*) a large drift in all directions with moderately long head of slightly greater breadth than the above, and cephalic index therefore usually 73·5–78·5. Hair as for (*b*). Stature moderate to short. Major drifts south of the great mountain zone of northern hemisphere, but later spreads northwards as ice sheets diminished, that to the N.W. (in Europe) becoming depigmented ;

(*d*) a drift especially N., but to some extent also S.E. with cephalic index 80+ because the head is relatively short and has a breadth 150+. Rounded head contours, broad short face in most cases, rather short nose of moderate breadth, stature rather short. Specializations within (*d*) gives (*d*, 1) the men with high short heads and prominent noses, and cephalic index most often over 85, and (*d*, 2) the men with flat-topped broad heads and cephalic index 85 ± and often sunken noses. Arguments can be given for origins of these characters on N. side of the supposed original H. sapiens-zone above-mentioned ;

(*e*) What is possibly a special modification of (*b*) above—a drift out from the steppe in the 'Bronze Age' as dry warmth developed. Very long narrow heads with cephalic indices usually below 73·5, but long narrow faces and prominent narrow noses giving a strong profile perhaps linked but with general growth in length.

It seems highly probable that Mendelian inheritance occurs widely, and this provides an explanation of the undoubted fact of the persistence of these types side by side in a population. It is useful to attempt to analyze samples in the light of the above list of drifts, but dangerous to plead for them as universal standards of reference because they are only inferences and need checking and adjustment. The only safe way is to study the bundling of physical characters in individuals and to see what are the more general bundlings in particular populations. Examples will be given and discussed.

19. Inter-caste differences in blood group distribution in Bengal.

E. W. E. MACFARLANE, Calcutta.

Blood group data were taken at Budge Budge, District 24 Parganas, from over 500 Bengalis. The caste and birthplace of each person was recorded. It was found that the percentages of A and B increase from the high to the lowest castes. The Caste-Hindus have over 40% of O. The Depressed Classes show 42·7% of B, which is the highest value for B yet discovered. All groups show the characteristic Indian condition of more B than A. The blood group proportions of the Bengali Mohammedans resemble those of all the local low caste Hindus taken together. This demonstrates that they are descended from local Bengali Hindu converts. There is less difference in blood group distribution between the highest and the lowest castes in Bengal than between high castes and untouchables in Cochin. The reduced Coefficients of Racial Likeness agree with the evidence of blood group data for the Bengali Brahmins, Kayasthas and Pods, also for Nairs and Illuvas of Cochin. The fact that the Pods and Illuvas show an association by the C.R.L. and no resemblance in blood group distributions may be significant in relation to racial migrations and the time of origin of the B mutation in India.

20. Studies on the heredity of palmar pattern.

P. C. Biswas, Calcutta.

This study is based upon the investigation of ten families, consisting of two and three consecutive generations. The main line formulæ, patterns on the hypothenar, thenar and interdigital areas and the occurrence of axial triradii show indications that they transmit hereditarily. Not only that but within families there occur patterns on the hypothenar and thenar eminences which resemble each other not only in their principal characters but even in some of their details.

21. Tri-clan and marriage-classes in Assam.

J. K. Bose, Calcutta.

The importance of tri-clan and marriage-classes has been stressed by anthropologists. But up till now very little field-work has been done on this line in India. In this paper an attempt is made to discuss the different varieties of marriage-classes found in Assam. The materials for the paper in most cases were collected by the author in the course of his field-work amongst the little-known primitive tribes on the Burma border of the Manipur State during the years 1931–1935. The tribes in which this system was recorded are Chirus, Chothes, Purums, Taraos, Kabuis, etc. There is a detailed discussion with diagrams on the working of this system amongst these tribes in the paper.

22. The Palaungs of the Shan hinterland.

M. R. Sahni *and* (Mrs.) Shyama Sahni, Calcutta.

The authors describe the social customs, migration, methods of cultivation and the geographical distribution of the *Palaung* clans and sub-clans inhabiting the Shan plateau. The *Draang* sub-clan, members of which build communal houses after the style of the *Dyaks* of Borneo, are of particular interest. The probable origin of some of the customs is discussed. The paper is illustrated by numerous photographs taken by the authors.

23. Dancing as a method of inducing ecstasy and frenzy.

N. N. Sengupta, Lucknow.

Dancing appears as a phase of religious rites. It is also a frequent accompaniment of religious festivals as an æsthetic phenomenon. The present paper is not concerned with either of these topics. Dancing is sometimes employed as a method of inducing a condition of religious ecstasy. We find it in different parts of the world and in different epochs of history. It is found in what was German Africa, and in Sumatra as a mediumistic phenomenon. It appears in the context of *Shamanism*. It was an important ingredient of the cult of Dionysos in ancient Greece. It manifested itself as a craze in Aix-la-chappelle towards the end of the 14th century. We find it recommended as an efficacious religious procedure in the context of the Chaitanya school of Vaishnavism.

The paper presents an analysis of this phenomenon and proposes a psycho-physical hypothesis for its interpretation.

24. Comparative anthropometry of the Pundits and Muhammadans of Kashmir.

H. C. Chakladar, Calcutta.

The writer measured in last May and June, 206 Pundits who are the Brahmins of Kashmir, and also 52 Muhammadans of the same State in which 22 measurements on the head and 30 measurements of the body proportions, and 40 observations were recorded. The Kashmiris were found to be of medium stature and highly dolichocephalic. Their hair is fine in texture. The nose has generally a convex or straight bridge and is often aquiline. Neither the malar bones nor the angles of the lower jaw are prominent. The eye-slit is always straight and of moderate breadth. The colour of the iris was observed to be deep brown and brown, only a negligible fraction having eyes with grey shades. The hair is black in 70 per cent. of cases, and the others showed light shades of red. The skin colour is generally tawny white. The vast majority of the Pundits are thin and slender. The Muhammadans show hardly any appreciable difference from the Pundits in any of the features.

The people of Kashmir appear to be of the Mediterranean race, showing less admixture with the brachycephals than even the people of Southern Italy.

25. Interparietal bone in man.

R. Krishna Rao *and* A. Ananthanarayana Ayer, Vizagapatam.

A big Interparietal bone, which is usually considered by anatomists as an exceptionally rare and uncommon find, was observed in one of the crania in the Department of Anatomy. This provided an occasion for making a detailed study of this bone with special reference to its incidence in crania of this part of the country. The study of 194 crania available here in the Department of Anatomy reveals that the percentage of occurrence of this anomaly is 15·46 and that the bone may be single, bipartite, tripartite or quadripartite, the parts however never exceeding the maximum number of four. A brief account of comparative anatomy and ossification has been included in the paper.

26. An enquiry into correlations between stature and arm-length, etc. between different social and occupational groups of the people of Bengal.

Bhupendranath Datta, Calcutta.

For this purpose, 190 subjects from 33 groups are chosen and thus divided: Caste-Hindus, depressed castes, Moslems, aboriginals. Again, these into manual and non-manual classes.

By calculation, it is found that correlation exists between stature and arm-length, the same is with hand-length save the manual-labouring class. Regarding hand-breadth, positive correlation exists only in 'All-Castes' group, but negative in stature and hand index. Again, correlation is positive between arm-length and hand-length. As regards arm-length and hand-breadth, correlations exist in 'All-Castes', 'manual' and 'non-manual' classes. There is no correlation in any group regarding arm-length and hand index.

Then the somatic proportions and ratio expressed in percentage are enquired into.

In conclusion it is found that, the Caste-Hindus are not dissimilar with the depressed castes except possessing longer hand-breadth and middle finger-length. But they are taller than the Mohammedans and possess longer hand-length and middle finger-length.

Again, there is no difference between the depressed castes and the Mohammedans, and the non-manual class is taller than the manual class.

27. The racial affinities of the Santals.

S. S. SARKAR, Calcutta.

The author has taken anthropometric measurements of 144 Santals from the interior regions of the Rajmahal Hills and has compared the metric data with those of the Mālērs of the Rajmahal Hills and the Mundas of Chota Nagpur. After a detailed comparison of the above data the author has come to the conclusion that there appears to be a fundamental difference in the headform and other somatic characters between the Mundari and Dravidian speaking peoples of Chota Nagpur. The Santals appear to possess a strong Australoid strain, in addition to a mongoloid element, as judged by the presence of epicanthic folds in their eyes and other characteristics.

28. The racial affinity between the Brahuis and the Dravidians.

C. R. ROY, Karachi.

The racial history of the Brahuis is a puzzle to the Anthropologist· Suggestion of racial connection with the Dravidians as they speak Dravidian language. Objections on the ground of supposed differences of physical features. Confusion of the Dravidians and Pre-Dravidians. Physical features of the Dravidians. They are akin to the Mediterraneans.

Haddon puts the Brahuis under the Indo-Iraneus group. Analysis of the anthropometric measurements of 100 Brahuis taken by the author shows a large percentage of the Mediterranean element. The original Brahuis belonged to the Mediterranean stock. They have been modified by the admixture of the *Homo Alpinus* and the Indo-Afgan. But they kept the original Mediterranean type among the higher classes. Social and marriage customs support the above analysis.

Common physical features point to the common origin of the Mediterranean, Brahuis and Dravidians. Dravidians entered India through the N.W. Frontier. Their possible route of migration. Type II Mohenjo-daro skulls as described by Dr. Guha confirms the theory of the Mediterranean migration about 2000 B.C. Relics of common material culture. A characteristic type of basket found among the both. Language, physical features and material culture all point to the racial connection between the Brahuis and the Dravidians.

29. The relationship of the Austric-speaking tribes of India with special reference to the Hos and Saoras.

D. N. MAJUMDAR, Lucknow.

30. Water-divining.

S. T. Moses, Baroda.

Water-divining and Animals. *Bhima's* horse. Water-divining and Man. 'Dowsing' an instinctive gift. Its uses and application in India. Krusadai island wells and salinity. Devaramalai well and 'Blood'. Dowsing and Rural reconstruction schemes. The Sceptic Linnaeus and his conversion. Explanation of the 'Dowsing' power. Scientific water-divining for borewells by the Industries department. Dowsing apparatus from Moses' Rod to Mansfield Patent Automatic Water-finder. Water-divining with cocoanut in Kerala. Well-digging in India. *Bhima* a water-diviner like Moses.

31. Studies in eyebrows among the Bengalis.

R. N. Basu, Calcutta.

Different forms of eyebrows—position of eyebrows—directions of the hairs—abnormal types of eyebrows—colour of the eyebrows.

32. Rudra-Çiva as an agricultural deity.

Nanimadhab Chaudhuri, Calcutta.

Çiva appears as a cultivator-god and a half-mad mendicant god of the lower classes in medieval Bengali literature. In Brahmanical society at the present time *Çiva* is specially worshipped as a giver of desirable husband and offspring, and as a curer of diseases. In non-Brahmanical society *Çiva* is worshipped as Mahadeva and under other names for the protection of cattle, recovery from illness, as a guardian deity of village and gate-keeper, and animal and other sacrifices are offered to him for good crops. In the Rig Veda, *Rudra* has no agricultural aspect. In the later Vedas, Brahmaṇas and Sūtras *Rudra* appears as a vagabond god of outcastes and skin-clothed forest and hill tribes, an inauspicious, malevolent god, a protector of cattle and a god connected with vegetation. In the Epic Age *Rudra-Çiva's* old attributes continue and new attributes are added. The old connection with vegetation develops into connection with food and agriculture, the means of producing food. The old vagabond god of out-castes is transformed by the addition of such attributes as 'Crazy', 'mendicant', 'clothed in rags', 'fond of dancing, singing and laughing', etc. The dual aspects of the medieval Bengal *Çiva* have thus been derived from earlier traditions.

33. Religious life of the Bunas of Bengal.

M. N. Basu, Calcutta.

In this paper the author discusses how the idea of religion came into the mind of the Bunas. The author also discusses the various worships of the Bunas and their origins and significances.

34. A preliminary study on the Brisakāstha of Bengal.

B. K. Chaudhuri, Calcutta.

Brisakāstha is the vedic *yūpa* transformed. Origin of the vedic *yūpa*. Evidences proving the existence of animal sacrifice (specially bull and cow) to the departed ancestors in the vedic and post-vedic periods. Provisional classification and description of the *Brisakāstha* of modern Bengal. Possible interpretations of the figure or figures carved on it. Method of disposal of the post and the underlying psychological concept discussed. Magical ideas associated with it pointed out. Distribution of the *Brisakāstha*. Its use as a memorial post, and as a post of worshipping the departed ancestors. Traces of the conception of fertility cult as found along with it. Conclusion.

35. A comparative study of the Athgarh (Orissa) skull.

H. K. Bose, Calcutta.

The skull was recovered at the time of re-excavation of an old well from a depth of 7½ ft. in a soil consisting of clay and water. The skull along with other bones of the skeleton and two iron objects (*kātāri*) and one copper bangle was found underneath a layer of stone slabs measuring 2 ft. × 1 ft. presumably the contents of a megalithic monument.

A detailed study of its anatomical peculiarities is given and comparison made with skulls found in other megalithic sites.

36. Blood sugar of the normal Bengali—its interrelationship with some body measurements.

M. L. Chakravarty, Calcutta.

From analogy of some well-known diseases such as high blood pressure occurring in short-necked people, etc., the author attempts here to find out if any body measurements, etc. have any correlation with the quantitative variation of sugar in the blood. The motive underlying is to detect such body changes, if any, peculiar to the corresponding quantitative variation of blood sugar in different individual and thereby to establish a *diabetic type* with its peculiar body measurements.

In the present work only one hundred normal Bengali Hindu adult males have been included and the result discussed.

37. The development of the head among the Bengalis.

T. C. Ray Choudhury *and* R. N. Basu, Calcutta.

The authors study the length, the breadth, the horizontal circumference of the head and the cephalic index in a developmental series of subjects from the age 17 to age 24 and show that so far as the head characters are concerned, the Bengali students attain their maximum development at the age of 19.

38. Language as an aid and obstacle to accurate thinking.

J. F. Bulsara, Bombay.

Since man is essentially a social animal, language arises as an inevitable social necessity at an early stage of human evolution. It is used as an instrument of communication of thought, feeling and ideas, and as such is helpful in developing thinking, expressing feelings and exchanging ideas among members or groups who are acquainted with the meanings of the socially adopted linguistic symbols.

The earlier content of language is concrete and the syntax simpler as is exemplified in the linguistic evolution of the child-mind, but the necessity of expressing and explaining more complicated ideas, and the need of symbolizing abstract notions, of specifying groups, etc. by single linguistic symbols is also felt at a fairly early stage of social development.

Thus language grows and in turn helps to clarify emotions, thoughts and ideas, and communicate them to fellowmen who understand the symbols adopted by the group.

Mind begins to expand, and in individual thinking and mutual talk or conversation linguistic symbols take on various shades of meaning or contents under different contexts of situations.

Thus language is partly affected and influenced by the behaviour, experience and culture of the particular society in which it has habitation and is a social product, imbibing in its structure the thought and behaviour patterns of the group in which it develops. The defects of logic and reasoning, the imperfect notions about the various aspects of nature and inaccuracies about nature of objects and phenomena gradually evolves to greater and greater precision as the experience and knowledge of the community increases.

The above can be exemplified not only from the language of children and from the language store of simpler peoples, but also from the linguistic habits of the less literate or developed section of an otherwise enlightened community.

A great part of our linguistic behaviour is a matter of habit, and even in an otherwise scientifically-minded community or group, language symbols are used loosely, vaguely or ambiguously. Metaphysics, logic, philosophy, and lastly science have largely been modifying the social usage of language from time to time.

These aspects of looseness, indefiniteness, emotional *affect* and inaccurate implication in the use of language symbols can be easily illustrated in such words as deity, God, spirit, sovereignty, religion, communism, imperialism, etc.

A large part of loose thinking and even inaccurate and unscientific representation in society is due to our linguistic habits and loose language symbols. This defect can only be removed by a greater study of our linguistic behaviour and a deeper analysis of the structure of language and greater care in the use of complex symbols round which have gathered from time to time the emotional re-action of the users and the 'social history' of the community.

39. Colour preferences of the Santals.

R. K. Mondal *and* M. N. Basu, Calcutta.

Experiments were done on hundred adult male Santals of Santal Parganas for determining the relative affective value of colour impressions. In the experiments seven colour papers were taken namely violet, indigo, blue, green, yellow, orange, and red. Testing the colour impressions of the Santals it is found that they have a preference for red. Experiments were done on two other groups of people of India and the results were compared.

In conclusion the authors state that with the present knowledge of psychology racial colour preferences possibly suggest that there may be some inherent psycho-physical differences between the different races of the world.

40. The marriage and nishpat customs of the Rishis.

N. Datta Majumdar, Calcutta.

The 'Rishis' or 'Rishisputras' are the leather-dressing and cobbler caste of Bengal. In this paper, a study has been made of the Rishis of Shahapur (population 1686), a village in the south-east corner of the district of Mymensingh. In the matter of marriage the ordinary rules as to prohibited degrees are followed, and a price has to be paid for the bride.

Widows are not allowed to marry. But the purpose of widow remarriage is served by a peculiar custom known as '*nishpat*' whereby a man employs a widow as a maid-servant, and lives with her as husband and wife without undergoing any ceremony whatsoever. Children born of such an union are not regarded as illegitimate. *Nishpat* sons are entitled to inheritance along with sons of regular marriage, the former getting a share of 6 annas while the latter 10 annas. But the former are esteemed lower in social status than the latter, and are not allowed to sit in the same line with them in social feasts.

The ' nishpat ' custom seems to be in an intermediate position between pure and simple concubinage and widow remarriage. The word ' *nishpat* ' is probably derived from the Sanskrit word ' *nishpati* ' which may be disjoined as ' *ni* ' plus ' *pati* ' that is, one who is without a husband.

41. On an improved model of the Profiloscope.

P. C. Mahalanobis, Calcutta.

A photographic profiloscope designed by the author was described in a previous communication to the Indian Science Congress in 1933 and 1936. The accuracy attained in profile measurements on photographs taken with this instrument was discussed in a paper published in Sankhyā, Vol. 3, Part 1 (March 1937).

Further improvement have been made to ensure greater accuracy in seating the subjects in the same standard position. The improved model and photographs taken with it will be exhibited.

42. Studies in blood groups in the Khasis.

R. N. Basu, Calcutta.

Blood from 50 individuals were grouped, and the percentage distribution determined and compared with other peoples.

43. Marriage ceremonies of the primitive tribes of Travancore.

L. A. Krishna Iyer, Trivandrum.

Marriage ceremonies are common in the savage world. The purposes of their performance are manifold and form a very fascinating study. The joining of hands is found among many savage tribes. It is the outward sign of a troth that the two persons give to each other. Very frequently, it is an act of union. Another wide-spread rite is to eat together. The bridegroom gives a ball of rice to the bride who in turn gives one which he eats. Mutual partaking of food is the strongest of all ties and breaks the most important of taboos, that are prevalent against eating together. Exchange of betelnuts is another custom found among the Malayarayans. The bride gives one half to her lover and chews the other half. They spit in the same spitoon. This consummates marriage. The presentation of a bamboo comb to the bride forms the essential part of the ceremony among the Muthuvans. Another rite is the custom of throwing of some kind of cereals and dried fruit on the couple. It is intended to give food to the evil spirits to induce them to be propitious and depart. Evils are averted from bride and bridegroom not only by positive rites, but also by abstinences of various kinds.

44. A prehistoric site within the city of Madras.

M. D. Raghavan, Madras.

In and about the city of Madras are a number of interesting prehistoric sites which await excavation. Practically at the western extremity of the city lies one such site now included in the garden of a house ' Fontenoy '. From time to time Mr. E. Prudhomme, the owner of the property, during the course of building operations had unearthed antique pottery including big sized urns. On his invitation, Mr. Cammiade had inspected the site. His retirement and departure from India prevented a close study being made of it. In August 1934, permission was obtained from the owner, by Mr. T. G. Aravamuthan and the author, on behalf of the Madras Museum to examine and excavate the site.

The site proved to be of more than ordinary interest, not the least remarkable of its features being the great variety of pottery forms met with, the site being closely packed with bowls and pots of black-tipped ware, specimens of all black pottery, large urns of coarse clay and big sized sarcophagi of the Perumbair type. Among the unique forms in pottery are a specimen of all-black bowl with a pointed end, recalling the shape of a half cocoanut with its sharp terminal, a goblet and a censer with fluted stem. The urns fall into three classes—the usual type of large wide-mouthed pyriform urns with the bottom cut flat, such as those found at Adichanallur and Perumbair; the less frequent type with the high neck and mushroom shaped body, and the elongated form with globular body ending in a short stem. Certain of the objects found are highly suggestive of the early Iron Age such as a hoe blade in iron of primitive type and a thick rod of iron. Among other antiquities are a hollow pottery bead and a well made figurine of black pottery in the form of a bird, which possibly are of the nature of votive offerings. Fragmentary pieces of bones found in one of the pots indicate that the people practised what is known as the secondary burial, where the body after a preliminary burial was exhumed, and a selection of bones given a ceremonial interment in cists or sarcophagi with elaborate ceremonials, votive offerings and offerings of food—an extension of the culture discovered in the sites in the neighbouring district, at Pallavaram and Perumbair.

The site was no doubt the burial ground of a settlement of great antiquity which lay in its vicinity; vestiges of which have been collected from the site occupied until a few years ago by the Government brickfields, extending into the property called Landon's Garden to the north of it. The full extent of the burial site could not be ascertained as the neighbouring areas have been largely built over.

The surface soil is sandy clay, which deeper down changed to the river sand variety. The moisture laden sand was not conducive to the preservation of pottery which softened and fractured, aggravated by the roots of the trees growing on the site.

* * *

SECTION OF AGRICULTURE

President :—Rao Bahadur T. S. Venkatraman, C.I.E.,
B.A., I.A.S., F.N.I.

General

1. Crop insurance for India.

B. Mukherjee, Lucknow.

This paper discusses economic planning of agriculture by crop insurance to minimize the uncertainties of cultivation. The problem is both new and important in a predominantly agricultural country like India.

The enormous advantages of crop insurance to the agriculturist, the consumer and the Government on the one hand, and for industrial development and the organization of agriculture on sound business lines on the other, are discussed.

The difficulties of the scheme are then explained. The actuarial calculation of premia present serious difficulties. There is no general formula which would apply in every case. The provision of storage throughout the country, the lack of telescopic faculty in the cultivator, his limited surplus and heavy debts, these and other difficulties are examined.

The insurance premium would be a tax on surplus while the taxable margin is low. The total cost would be high but it would be largely offset by reduction in other charges for the cultivator. Further, the cost can be minimized in other ways which are explained.

The paper pleads for a modest beginning in the planning of agricultural reconstruction by crop insurance. It also pleads for an enquiry by a Government Committee for framing a practical scheme.

2. A new *rabi* crop (sugar beet) for irrigated tracts.

K. I. Thadani, Sakrand (Sind).

The Agricultural Department in Sind is in search of alternative crops for wheat with a view to provide the farmer with crops more remunerative than wheat and at the same time have a wider range of sowing period during the rabi season since wheat, which is at present the predominant rabi crop, has a very limited sowing period. The main idea is to spread out the demand for irrigation water and, at the same time, to increase the area under rabi crops.

Attention was therefore directed to the trial of sugar-beet. An experiment was conducted at the Agricultural Research Station, Sakrand during 1936-37. Five varieties, three from England and two from U.S.A., and four sowing dates, viz. 26th October, 2nd, 9th and 16th November were tested. The seed was sown on ridges at the rate of 4·5 lbs. per acre. The results have indicated that the crop is capable of yielding 250 maunds (80 lbs. a maund) of beets per acre for sugar manufacture and in addition about 300 to 400 maunds of tops for feeding cattle. Early sowing, viz. 26th October, was found to be more satisfactory than later (November) sowings. The crop is ready for harvest by end of March when the sugar contents reach 13 to 14%. No conclusive results were obtained with regard to the varieties tested. Sugar beet is a five-month crop like wheat, and requires much less water than sugar cane which is a 12-month crop. Taking price of beets at 4 annas a maund, the gross income from the crop will be Rs.62 from which has to be deducted a sum of Rs.15 for extra cost on manure and seed. This leaves a sum of Rs.47 per acre as compared to Rs.30 from wheat. The results, however, require confirmation.

3. The use of tender leaves as cattle food.

B. N. BANERJEE *and* G. B. RAMASARMA, Bangalore.

A dozen varieties of leaves that are fed to goats and other cattle, during the dry months of the year, were analyzed for their carotin, protein, calcium, and phosphorus contents. Their nutritive value is high and compares favourably with green grass (*Cynodon dactylon*). They are rich in lime and contain enough phosphorus and protein. The carotin content is also high. Tannins, alkaloids and other bodies, that may act as stomach irritants or poisons, need to be examined in particular cases. The results indicate the possibility of utilizing such vegetation as cattle food in India where the fodder problem is one of major importance.

4. Nekalam universal drill.

N. ALAM, Punjab.

The author describes a seed drill of his own invention which is cheap, simple and efficient. It is suitable for sowing most crops. The machine is supplied with either one tined or five tined drills.

5. Agricultural meteorology in India.

L. A. RAMDAS, Poona.

The paper discusses the main contributions made in India to the new science of Agricultural Meteorology. The investigations made at Poona on micro-climatology, precision observations, influence of weather on the yield of crops and on the areas sown, the thermal balance and the water balance at the soil surface, methods of influencing climatic environment for given purposes, and evaporation are briefly discussed. Another important subject engaging attention at Poona is the study of the meteorological factors controlling nocturnal cooling of the air layers near the ground. By statistically examining past meteorological data accumulated by the India Meteorological Department, it has been possible to investigate dates of onset of the south-west monsoon, and the frequency of phenomena like heat and cold waves, droughts, floods, hail storms, etc. The possibility of predicting maximum and mimimum temperatures by statistical methods has also been investigated. A number of new instruments have been devised for work on Agricultural Meteorology.

In conclusion the importance of liaison work in connection with issue of warnings to farmers, and training of agricultural workers in Agricultural Meteorology is stressed.

6. A new method of determining seepage.

V. I. VAIDHIANATHAN *and* H. R. LUTHRA, Lahore.

A new method has been developed to determine the seepage from canals in waterlogged areas. The method depends on: (i) the determination of subsoil flow by an electrical method, (ii) the determination of the angle which the outermost stream line of the subsoil flow makes with the vertical, and (iii) the integration of the flow for a cross-section under the canal. The method has been developed in the field in connection with the determination of seepage from a big canal in the Punjab.

7. Recent progress of agricultural marketing work in India.

A. M. LIVINGSTONE, Delhi.

Introductory : Marketing recommendations of the Royal Commission on Agriculture (1928). Appointment of Marketing Staffs by the Imperial Council of Agricultural Research and by Provinces and States (1935). Commencement of all-India marketing surveys on various important commodities. Nature of surveys and publication of reports.

Grading and Standardisation : Need for standardisation owing to the widespread evils of adulteration. Scope of Agricultural Produce (Grading and Marking) Act, 1937. Experiments in grading eggs, fruits, hides, tobacco, etc. Practical difficulties and results showing extent to which enhanced prices of graded produce cover the costs of grading.

Standardisation applied to staple products through Trade Associations. Harmful effects of varying contract terms in different markets. Introduction of standard all-India contracts for cereals and oilseeds. Bearing of standard contracts on 'futures' trading. Need for limited number of representative associations controlling trade terms. Formation of Tanners' Federation, Tobacco Association, etc. Is statutory sanction necessary for such bodies, c.f. East India Cotton Association, Bombay ?

Special position of Indian Central Committees for Cotton, Lac, Coffee, Jute and Sugar and their activities in regard to marketing.

General Development Work : Further measures designed to increase the efficiency of distribution and for returning better prices to cultivators. Improved market news service. Advantages of broadcasting and use of vernaculars. Recent advances. Fundamental difficulty of comparing prices in absence of standard all-India weights. Position regarding adoption of a standard tola (180 grains Troy), seer (80 tolas) and maund (40 seers). Elimination of waste by improved methods of storing wheat and the introduction of cold storage and transport for perishables. Multiplicity and variable nature of market charges. Measures to secure uniformity and reduction of high charges. Causes of slow progress in the establishment of regulated markets. Comparative failure of co-operative trading societies due to bad management. Could this be cured by applying some kind of managing agency system to these societies ?

Conclusions and probable lines of future development.

Plant-breeding and Genetics.

8. Some aspects of plant breeding in India.

V. G. PANSE, Indore.

Examination of figures for 1934-35 reveals that the area under improved varieties of important Indian crops, except sugar cane is under twenty per cent. While several causes may be responsible for this, it is clear that the great scope for improvement of crops in India is not yet exploited to any appreciable extent. Some suggestions are made for an efficient handling of available breeding material. They include formulation of a clear breeding policy, proper testing of breeding material and the strains evolved by statistically sound methods and examination of the maximum capacity of a strain to respond to selection. The importance of genetic studies in quantitative characters is emphasized.

9. An important genetic constant.

N. Alam, Punjab.

The theory is advanced that for any quantitative character there is a definite relation between the average values of both the parents and any two successive generations. When an algebraic equation is fitted, the sum of the averages of any quantitative character for both the parents and the preceding generation out of any two filial generations, is equal to three times the value of the succeeding one. Thus, if once the values for both the parents and any one generation are known the values for the other generations can be calculated.

10. Hybrid vigour in rice.

K. Ramiah *and* K. Ramasamy, Coimbatore.

A big population, of over sixty to hundred plants in each F_1 of four sets of crosses in rice with parents of varying grain size, was studied for several quantitative characters chief of them being tillering and grain yield. The weight of the crossed seed was found to be bigger only when the female parent had a smaller grain than the male parent. In one cross involving two widely differing parents in grain size, the embryo size was the same both in the selfed and hybrid seed when the bigger grained parent was kept as the mother but was definitely less in the reciprocal cross. Heterosis as measured by tiller production was not directly related to embryo size. The hybrid has a better initial start which, however, is not maintained at the later stages, the initial differences tending either to decrease or increase, thus suggesting that embryo size is not the principal factor accounting for heterosis. It is possible that the endosperm in which the initial embryo is nurtured plays as important a part as the embryo itself.

Heterosis when present generally manifests itself by greater tillering, by larger number of ears per plant, by longer panicles, by earliness in flowering and by larger yield per plant though the amount of such manifestation may vary with particular crosses. Heterosis by increased plant height occurs only very rarely.

11. The effect of certain external factors upon the manifestation of hybrid vigour in wheat.

B. P. Pal *and* Nek Alam, New Delhi.

Hybrid vigour was studied intensively in a cross between Pusa 52 and Pusa 165 wheats under different dates and times of sowing, different depths of sowing and different conditions of spacing. The characters studied were : germination, rate of formation of first four leaves and the first tiller, height of plant, tillering, number of leaves per plant, length of ear, number of fertile and sterile spikelets, number of grains per ear, weight of grain and yield.

The data indicated that the expression of heterosis was greatly influenced by the several external factors studied.

12. X-ray mutations in rice.

K. Ramiah *and* N. Parthasarathy, Coimbatore.

The paper deals with a large number of mutations obtained by X-raying rice seed at the Paddy Breeding Station, Coimbatore. Among the mutations described, thirteen refer to various forms of chlorophyll deficiency of which half a dozen occurring as natural mutations have been described previously. The other mutations refer to different forms of spikelet sterility, grain size and shape, leaf size and type of panicle. X_2 and X_3 generations have been raised to study the genetics of these mutations. Such studies on the partially sterile mutations show some interesting associations between sterility genes and genes controlling such characters like awning, grain size, flowering duration, size of leaf, stature of plant, and colour of lemma and palea.

Some of the homozygous types isolated from the segregating families are promising economically since they are identical with the original X-rayed parent except for slight improvement in vigour (greater tillering) and small differences in height and flowering duration. Yield trials are in progress to test their usefulness.

13. Inheritance of size and shape of grains in rice.

S. K. MITRA *and* P. M. GANGULI, Assam.

The length of spikelets in rice has been observed to segregate in the F_2 in the ratio of 3 short to 1 long. The existence of variation within the groups of short and long spikelets can probably be accounted for by minor modifying factors also operating besides the main one.

With regard to the breadth of the spikelets the F_2 and F_3 frequencies give only normal distribution showing that the inheritance of breadth is of the multiple factor type.

No correlation was found to exist between the length and breadth of spikelets amongst the F_2 population of the cross made to study the spikelet size.

14. The genetics of Mung (*Phaseolus radiatus* Linn.).

R. D. BOSE, Pusa.

Genetical studies in some species of *Phaseolus* such as *Ph. vulgaris Ph. chrysanthus*, *Ph. multiflorus*, etc. have been reported by workers abroad but no genetical results in mung or *Phaseolus radiatus* Linn. (syn. *P. aureus* Roxb.) appear to have been published up to now. The mode of inheritance of colour in the flower, unripe pod, and seed-coat as well as that of quantitative characters such as maturity, length and diameter of pods and the relation of these characters to each other have been studied at Pusa and described in this paper.

The cross was made between Pusa types 18 and 36, the former having dark green, dull seeds, and light yellowish-olive flowers while the latter has pale lemon-yellow coloured seeds with a shining surface and olive-yellow flowers. Monogenic inheritance has been observed in this cross for flower colour and the nature of the seed surface, olive-yellow flowers and shining seed surface (both like those present in type 36 parent) being recessive. Two genes appear to be responsible for the inheritance of the seed-coat colour.

Transgressive segregation has been noted in the maturity of the mung hybrids as well as in the length and diameter of its pods. The colour of the unripe pod has been found to be completely linked with that of the flower whereas there is no linkage between seed-coat colour and the nature of the seed surface nor between any of these two characters and flower colour. Neither there is any relationship between any of the qualitative with the quantitative characters studied.

A correlation of $r = 0{\cdot}50 \pm 0{\cdot}03$ has been observed between the length and diameter of pods but no relations exist between these two characters and maturity.

15. Colour inheritance studies in Indian chillies (*Capsicum annuum* L.).

R. B. DESHPANDE, New Delhi.

The paper describes the results of crosses between a yellow-anthered mutant chilli, type 11A, and two Pusa types, type 3 and type 29, the former having purple petals, anthers and nodes and the latter having white petals, purplish yellow anthers and pale purple nodes. The results show that the yellow anthers of type 11A are recessive to the two kinds of purple anthers found in type 3 and type 29 respectively on a monohybrid ratio.

The expression of purple colour in any organ is shown to be dependent on the presence of a factor, *S*, which also determines the purple colour both in anthers and nodes.

The segregation of anther and node colour in relation to petal colour was found to be on a ratio of 36 purple petal, anther and node : 12 white petal, purple anther and node : 16 white petal, yellow anther and green node.

16. Cooking tests with Pusa types of pigeon-peas (*Cajanus Cajan* (Linn.) Millsp.).

R. D. BOSE, P. M. GANGULI, *and* S. M. UMAR, Pusa.

The ultimate test for all food crops is their cooking value and hence in all programmes for improvement of such crops the cooking test should occupy an important place. Eighty-six Pusa types of *rahar* (*Cajanus*) and 6 hybrids were tested for their cooking properties and classified into three main groups for taste. This character was correlated with others and it was found that some correlation was present between taste and adherence of husk to the *dal*, colour of the raw and of the cooked *dal* as well as with the time taken to cook. No relationship was observed between the taste of the *dal* and the habit, maturity, flower and pod colours, size and shape of grain, yield, percentage of husk and the consistency of the cooked *dal*.

17. The inheritance of basal feathered stigmas (and basal barbed subules) in Sorghum.

G. N. RANGASWAMI AYYANGAR *and* T. VENKATARAMANA REDDY, Coimbatore.

A gene $\mathrm{St_{Bf}}$ North Rhodesian in origin, is responsible for the stigmas being fully feathered in Sorghum. $\mathrm{St_{bf}}$ results in stigmas whose basal one-third alone is feathered, leaving the top two-thirds of the feathery area devoid of feathers and simply columnar. This restricted feathering has not affected seed setting and has been noted to occur in varieties with gaping glumes. $\mathrm{St_{Bf}}$ is a simple dominant to $\mathrm{St_{bf}}$. In awned varieties this differentiation in the feathery area shows a parallel effect in the homologous organ, i.e. the subule of the awn. When the stigma is fully feathered, the subule is fully barbed and when the stigma is basal feathered, the subule is basal barbed. The $\mathrm{St_{Bf}}$-$\mathrm{St_{bf}}$ factor pair behaves in inheritance independent of the sheath colour factors P and Q and of the grain colour factors B_1B_2 and W.

This is the first record of a restricted feathered stigma in Gramineæ. This kind of a stigma is a varietal characteristic and is mendelian in inheritance.

Study of Crops and Crop Products.

18. Water requirements of sugarcane varieties during hot weather.

K. L. KHANNA *and* P. C. RAHEJA, Bihar.

Hot weather in North Bihar constitutes a critical stage in the growth cycle of the cane crop. During this period the crop that is usually rainfed has solely to depend upon the water present in the subsoil left over from the previous monsoon while the increasing stress of soil dryness on the crop is relieved only after the next monsoon sets in. The suitability or otherwise of a variety for this tract, therefore, depends largely upon its efficiency to tide over the hot weather. Studies were, therefore, conducted during this period to work out the water requirements of varieties belonging to three distinct groups namely drought enduring, drought escaping and the definitely mesophytic. The results obtained from this field study are summarized below :—

Sugarcane varieties differ widely in their relative efficiency of water requirements and varieties most likely to suit North Bihar tract need have relative efficiency of water requirements equal to or greater than that of 0·33.

A linear proportionality was found to exist between the relative water requirements of varieties and the dry matter produced by them.

A high negative coefficient of correlation was observed between the assimilation capacity of plants and their relative water requirements.

Capacity of varieties to resist drought did not necessarily mean an economical use of water by them.

Degree of development of transpiring surface also did not exhibit any relationship to the relative water requirements of varieties.

19. Analysis of certain varietal characteristics in sugar-cane with reference to drought-resistance and yield.

·R. N. MATHUR, Shahjahanpur.

The results of a physiological enquiry into certain characteristics of sugar-cane varieties in relation to their drought-resistance and final yield are presented. Thirteen varieties of known performance: (i) drought resistant—Co. 285, 205, 248, Desi and S. 114, (ii) medium resistant—Co. 213, 313, 290, 281 and 331, (iii) drought susceptible—B. 6308, P.O.J. 2878 and Co. 515, were selected and studied for germination, tillering, leaf area, length, width, and water-content, cane height, internode length and thickness, arrowing, final cane yield, sucrose content, etc.

After the monsoon period drought resistant varieties are found to possess usually more than four tillers and the susceptible ones not more than two per plant. The intermediates carry between two and four tillers. High tillering canes are not necessarily heavy yielding; indeed heavy yield is associated with medium tiller production.

Drought resistant varieties are further, average yielders and characterized by thin canes, profuse flowering, narrow leaves with low water-content and low sucrose contents. Susceptibles on the other hand possess thick canes with deficient yield, no flowering, broad leaves with high water-content and high sucrose. Varieties called medium resistant are generally observed to be thick caned, heavy yielding and high in sucrose content; with respect to leaf width and water-content they occupy an intermediate position.

Certain yield relationships are also included.

20. Top/bottom ratio method of determining maturity of sugar-cane.

K. V. S. Satyanarayana, New Delhi.

From physiological and biochemical studies, Viswa Nath showed that in a normally grown, ripe sugar-cane crop, the top/bottom ratio method of determining maturity of the cane is the most reliable and least affected by environmental factors.

This paper confirms Viswa Nath's finding and presents data which show that the top/bottom ratio is independent of manurial treatment and gives a correct index of the maturity of the cane.

21. Observations on the origin of lint and fuzz hairs in cotton.

V. Ramanatha Ayyar *and* G. Seshadri Ayyangar, Coimbatore.

In a previous paper, it was shown that primordial lint cells could be identified by their characteristic nuclear changes and that hairs were also produced from the sub-epidermal region below the stomata, and these seemed to correspond to the fuzz hairs found on the mature seed-coat. Since then, a large number of cotton varieties were examined for these two types of hairs. All of them confirmed the original observations on the differentiation of hairs. The primordial lint nuclei were found to behave in a manner different from that of mitotic nuclei of the epidermal cells. Studies on the lintless types disclosed that five patterns of lint development ranging from absolute lintlessness to normal lint-formation could be distinguished. In two of them, the primordial lint nuclei were found to disintegrate and in other two, they underwent regularly all the changes, but subsequent growth of the hairs was found arrested, at different levels. Further observations made on the stomatal hairs showed that these are identical with fuzz hairs. They were more clearly brought out on the comparison of ovular sections of naked and fuzzy types which in addition, exhibited a difference in the nature of their stomatal air-cavities.

22. Biennial bearing in mangoes.

P. K. Sen, Sabour.

The problem of 'biennial' or 'alternate' bearing in mangoes is discussed and the need for overcoming this difficulty stressed. The cause of the phenomenon and possible methods of control are indicated. It is pointed out that a thorough investigation into the nature and habit of growth of the mango and of factors involved is essential for successful production of the fruit and effectively remedying its biennial bearing.

23. Certain metabolic variations and growth rate of Malta oranges.

J. C. Luthra, Punjab.

It is recognized that the study of metabolic activities of fruits during their course of development furnishes important data which can be helpful in explaining the changes in the body of ripe fruits exposed to conditions of cold and gas storage. The paper embodies results of an investigation on the respiratory activity, relative growth rate and nitrogen content of developing Malta oranges. It is interesting to note the parallelism between the respiratory activity, growth rate, and nitrogen. They are very high during the adolescent stage and fall off continuously as the fruit ages. The second high value of respiratory activity occurs at the climacteric stage and marks the onset of colour changes in the fruit from green to greenish yellow and finally to orange yellow.

24. Effect of ' short ' and ' long ' day treatment on the flowering duration of different classes of paddy.

M. ALAM *and* A. B. SARAN, Sabour.

An important problem in rice-breeding is the crossing of varieties widely differing in their flowering duration—which is more or less fixed in case of ' *Aman* ' or winter paddies—and as such it is not ordinarily possible except by utilizing late tillers of the earlier variety. This, however, is not always possible especially when the interval between the flowering duration of the varieties to be crossed is fairly long. Besides this, the setting of grains in such late tillers is also poor. In view of these facts, two sets of experiments were laid to investigate the possibility of altering the flowering duration of the so-called ' timely-fixed ' paddy varieties, by (1) increasing, and (2) decreasing the ' day length ' artificially. The ' day length ' was increased by illuminating the plants with Petromax light during the night, whereas the shortening was effected by removing the plants from full day light to complete darkness.

The effect of both these treatments on the flowering duration of the paddy plants is quite distinct. By increasing the ' day length ', flowering date is appreciably delayed, whereas by decreasing it, the plants are induced to flower earlier. The actual shifting of the flowering dates, however, is found to depend on the period for which the actual treatments are given. By adopting one of these methods a definitely ' late ' variety has been crossed with a distinctly early one, which was not possible before.

25. Physiological studies of salt tolerance in paddy.

M. ALAM *and* A. B. SARAN, Sabour.

The occurrence of large saline areas near the sea coast and also around the Chilka lake in Orissa has rendered difficult the problem of successful growing of paddy which is the only crop that can be cultivated in the tract. Investigations on various aspects of the problem have, therefore, been in progress for the last 3 to 4 years at the Bihar and Orissa Rice Research Station, Sabour. Results of preliminary investigations were communicated at one of the previous sessions of the Congress, but since then a good deal of progress has been made, especially on two aspects of the problem, viz., gradual education of paddy plants to tolerate salinity and pre-treatment of paddy seeds with minute doses of common salt solution before growing them in saline soil.

Results obtained from both these investigations are interesting and point to the possibility of growing paddy in saline areas by either of these methods. Pretreatment of seeds with minute doses of common salt, however, appears to be more promising and is a novel method of solving such problems. The best results have been obtained when seeds are soaked in ·000,000,1% salt solution. Paddy seeds of a non-saline variety soaked in this strength of salt solution were actually grown in saline tracts of Orissa as well as under Pot-Culture conditions, where artificial salinity was induced. The actual data obtained point to the definitely better performance of the treated seeds than the untreated ones.

26. Nicotine and its movement in tobacco and in tobacco-tomato grafts.

B. VISWA NATH *and* B. P. PAL, New Delhi.

Nicotine content in different plant-parts of grafts between tobacco and tomato was studied. The tomato scions in grafts where tobacco was used as the stock distinctly showed the presence of nicotine suggesting upward translocation of the alkaloid manufactured in the tobacco stock whereas in the reciprocal grafts the tomato stocks were devoid of nicotine and the quantity of the latter in the tobacco scions was very much reduced.

Nicotine content increased with maturity in the tobacco plants up to a stage after which there was a decline.

✓27. Studies on the storage of potato and its damage by heat-rot.

P. B. Sanyal, New Delhi.

Great damage is done to potatoes in North Bihar during storage through heat-rot. Drastic antiseptic treatments such as dipping in copper sulphate and sulphuric acid solutions, fumigation with CS_2, keeping with sulphur, tobacco powder and lime proved ineffective when the mean atmospheric temperature persisted for some time at 85°F. or more.

In two years' storage experiments it was found that smaller tubers preserved better while their dryage was more. Bigger ones are more susceptible to heat-rot. Cultivators sometimes lose as much as 90 per cent. of the crop.

Two factors, viz. high temperature and humid atmosphere, are chiefly responsible for the huge waste of potatoes. Prior to rotting, the tissues first get blackened, then soften and finally a frothing emulsion oozes out. Decrease in albuminoid nitrogen, increase in ammoniacal nitrogen and the formation of dextrine were noticed during rotting.

Respiration of tubers was studied. Respiratory ratio increases with temperature and catalase activity decreases till the tubers suffer injuries in their tissues producing black patches and finally these are attacked with bacteria or fungi producing heat-rot. On cold storage the respiration is slower and injury or blackening of the tissue is much less.

The whole problem of storage of potato, therefore, rests on the avoidance of stimulation to enhance tissue-respiration. This is attained by storing the tubers in cool, fairly dry places. Common air-cooled storage houses in which cold air is admitted at night may serve the purpose. Next best is to store potato on the ground over a bed of sand. It is economical to use small tubers for seed purposes, as they keep better and smaller quantities by weight are required for sowing, while the outturn is the same as from medium or big tubers.

28. Potassium ferricyanide method for the estimation of reducing sugars in cane juice.

K. L. Khanna *and* S. C. Sen, Pusa.

Fehling's method for the estimation of glucose in cane juice is now widely accepted although the necessary use of sodium phosphate filtrate makes it laborious and time-consuming so that where many rounds of analyses have to be completed within the course of each day as is the case in Sugarcane Research Laboratories an accurate yet quick method is a desideratum.

One such method has been found in the direct use of lead sub-acetate filtrate for titration against 1% alkaline Pot. Ferricyanide solution. The method which qualifies the amount of lead sub-acetate to be used for clarifying the original cane juice (2-3 grams for 150 c.c. of cane juice) gives results closely corresponding to those that are obtained with sodium phosphate filtrate by Fehling's and Ferricyanide solutions. The advantage is evident as both the estimations of sucrose and glucose can be done from the same filtrate.

29. Properties of jaggery in relation to moisture.

T. Varahulu, Coimbatore.

The responses of good and bad jaggeries to 0·0%, 50%, 60%, 75% and 100% relative humidities were studied. The study revealed several important properties which are so distinctly characteristic of each of the two types of jaggeries studied.

It was indicated that the good jaggeries have a more open texture with capacity to either give up, or take in, moisture readily. They possess a considerable strength of surface, which enables them to hold large amounts of water in surface solution without their structure showing any signs of collapsing. They so characteristically retain but comparatively small amounts of water when at equilibrium in any given humidity below the saturated.

In all these respects the bad jaggeries stand in striking contrast to the good ones.

It was suggested that the moisture content of a jaggery at equilibrium with any given humidity below the saturated might serve as a reliable single value to qualify and evaluate its keeping capacity.

That the water in jaggery might be existing in two forms, viz. as 'free' and 'bound' water, and that the latter might have been held by forces of adsorption, was also suggested.

It was seen that both the good and the bad jaggeries might cease to manifest their hygroscopic tendencies at some humidity which might be lying between 50% and 60% relative humidities.

30. New cane varieties from Coimbatore.

N. L. Dutt, Coimbatore.

Attention is drawn to the new varieties of thick canes Co. 419 and Co. 421. The indian cultivator is familiar with the medium canes Co. 213, 285, 290, 313 and 331 which are serving him and the industry so efficiently. The new canes like Co. 419 are different as they contain more of *Pounda* or *Saccharum officinarum* blood.

Co. 419 has, in the trials at the experiment stations in the Bombay and Madras Presidencies as also in Burma and Assam, out-yielded the famous 'wonder-cane' of Java, P.O.J. 2878 and the local canes.

Co. 421 is considered a serious rival of Co. 213 and other medium canes in North India.

Co. 419 thus holds out promise of usefulness for tropical India and Co. 421 for certain parts of sub-tropical India.

Statistics and Plot Technique.

31. Test of significance of treatment means with mixed-up yields in field experiments.

S. S. Bose *and* P. C. Mahalanobis, Calcutta.

In a previous paper, the formulæ for estimating individual yields, in the case of an experiment with two or more plot yields being mixed up, have been worked out by the method of minimizing residual variance. It is shown, in the present paper, how the standard errors of the treatment means may be calculated as a linear function of the known yields in the case of the standard methods of field experiments and how these errors may be utilized for testing significant differences between observed treatment means.

32. A complex experiment on winter rice at Dacca farm, 1936-37.

S. Hedayetullah, K. P. Roy, *and* P. C. Mahalanobis, Calcutta.

A complex cultural experiment was conducted at the Dacca Farm in 1936 to study the effect of three cultural factors on the yield of a selected strain of transplanted winter rice.

The three factors were : (i) five dates of planting, (ii) six ages of seedling, and (iii) three seedling numbers.

The experiment has shown—

(i) that almost for any date of planting, seedlings of six weeks age give the best results ;

(ii) that for early plantings, one seedling gives the highest yield but its superiority to larger number of seedlings diminishes as the planting is delayed. This is true of seedlings two, three and seven weeks old, but the other age groups do not show this difference ;

(iii) that there is a decrease of yield for one seedling group in the early August plantings but for the other two seedling groups there are occasional significant increases ;

(iv) that in late August plantings 'one seedling' is superior to others and it is due only to two and three weeks old seedlings ;

(v) that in early September planting, the yields of one seedling group begin to fall till they are completely superseded in the late September plantings by the local method of planting 3-4 seedlings per hole.

33. A complex cultural experiment on rice.

S. C. Chakravarti, S. S. Bose, *and* P. C. Mahalanobis, Calcutta.

The paper describes the results of a complex four-factor experiment on rice carried in four successive seasons at the Chinsurah Farm between the years 1933–1937. The crop was almost a failure in the third year. Three years' data have therefore been analyzed in this note. The results show that Bhasamanik is the best under Chinsurah conditions, that August 1 is the optimum date of planting and that close spacing and increased number of seedlings per hole are necessary to insure against late transplanting, particularly in a year of adverse rainfall condition.

34. A study on tillers of rice plant bearing on their duration of life, performance and death.

K. C. Banerji, J. R. Pal, *and* P. C. Mahalanobis, Calcutta.

With a view to study the mortality of rice tillers in relation to their time of emergence on the mother plant, relevant data were collected from a pot culture experiment in the Bankura agricultural farm. The tillers as they emerged were marked out with a ticket showing the date of emergence and in the event of death the date was inserted on the ticket. The results show that the early tillers contained a greater proportion of grain-bearing tillers than the late ones and that the heavily manured soils always delayed the period of maximum tillering activity compared to the unmanured or light manured ones. It was also found that of the tillers that emerged in the first fortnight of August, 12 per cent were ineffective; those of the second fortnight, 30 per cent were ineffective. Of the tillers of the first part of September, 75 per cent were ineffective while all subsequent tillers were wastes. The contribution to final yield of the tillers of these four periods were respectively 22, 59, 18 and 1 per cent. The question is asked, whether it would be desirable in the interest of high yield to remove all tillers born in the last two periods.

35. Preliminary studies on sampling in field experiments.

V. G. PANSE, Indore.

Sampling was tried in several replicated field trials conducted at the Institute and outside to study stand, height, number of fruiting nodes and sheds, and infection by red-leaf and leaf-roll in cotton, incidence of frost in linseed, number of tillers in wheat and barley, and yield in cotton and wheat. Five to ten individual plants or two to five observation rows, each three or four feet long distributed at random in the plot, were employed as sampling units. In linseed half the length of a random row was observed. The sampling adopted was found fairly satisfactory for all characters except yield. It has been shown from a consideration of sampling variance that more extensive sampling by the present or slightly modified methods would ensure greater accuracy.

Sampling can be utilized to the best advantage for taking subsidiary observations rather than for estimating yield and investigations should be concentrated on this aspect of the problem.

Crop Enemies.

36. The relation of Lantana to the spread of spike and a cheap method of eradicating the same.

A. V. VARADRAJA IYENGAR, Bangalore.

Lantana is an exotic which belongs to the family of Verbenaceæ of which the teak is an important member. It has invaded within a few years many provinces and has proved itself a menace. In the Deccan plateau in particular, the development of sylviculturally useful species of plants is seriously threatened. Its cultural characters and nutritive requirements have been studied.

The problem of controlling this vigorously spreading species is considered under three heads: (i) *Removal of the existing crop.* The cover as it occurs to-day in some of the localities represents a wide impenetrable mass of bushes which some times reach to a height of 10 feet and more. In view of its thorny nature, the bush cannot be easily managed. Though the employment of elephants, etc. has been suggested for removing the crop, the process is obviously costly. It has however been possible to control the species through application of chemicals such as sodium chlorate. The results obtained with vast areas of Lantana are discussed. Removal of Lantana through cultural operations has also been considered. (ii) *Elimination of seedlings.* When the existing cover is removed, millions of seedlings arise from the seeds that lie dormant in the soil provided the conditions are favourable for their regeneration. Light and moisture form two more important factors in this connection. Among the many chemicals tried to control the seedlings, thiocyanates were found to be the most potent. (iii) *Control of viable seeds lying dormant in the soil.* Although Lantana can be disseminated through cuttings, root suckers, stump plantings, etc. regeneration through seeds is the most naturally occurring one. Attempts are in progress to treat the soil in a simple way with a view to inhibiting the viability of seeds.

37. Sugar-cane mosaic disease in India.

B. L. CHONA *and* S. A. RAFAY, New Delhi.

A brief account of history, distribution and economics of mosaic disease of sugar-cane in India is given.

From fundamental aspect of mosaic virus study regarding physical properties, transmissibility, etc. following points are of chief interest :—

Under Northern India conditions mosaic disease is not doing much damage—the losses being only about 10% reduction in the yield of cane (Co. 213) even in the experimental plots with as high as 60–80% mosaic incidence. Recent tonnage experiments with thick canes have revealed greater losses.

Mosaic virus is not uniformly distributed within the cane as some setts from middle and lower portion of the affected cane give rise to apparently healthy plants ; recovery varying from 0 to 40% depending on the variety.

Thermal death point determinations of mosaic leaf juices of different cane varieties reveal a wide variation between 45°–65°C.

These strongly suggest the existence of more than one mosaic virus strain.

Sugar-cane mosaic virus is sap-transmissible but Chamberland Candle filtrate is non-infectious. It is not seed-transmissible either.

Sugar-cane mosaic virus is rather of a sensitive type, having a low ' thermal death point ', very short life in vitro, inactivation at dilution beyond 1 : 10 and with dilute concentrations of acids and chemicals but does not seem to be affected much with oxidation.

Mosaic virus of any cane variety easily infects other varieties and also maize, jowar (Sorghum) and teosinte (*Euchlaena* sp.). Reverse inoculations, i.e. maize and jowar mosaic leaf juice inoculated into cane have given successful infection.

Season seems to influence greatly the artificial transmission of the disease. Months of May and June at Pusa always gave very high percentage of successful inoculations. Similar seasonal influence has been noticed under Delhi conditions also.

A large number of important sugar-cane varieties have been tested for their resistance to mosaic. Co. 214, 244, 285 and 290 are comparatively more resistant, while Co. 213, 223, 312, 313 and 331 have proved very susceptible.

There are indications of active natural transmission under Coimbatore, Gurdaspur and Jullundur conditions ; to a slight extent at Lyallpur and in traces at Karnal (as observed this year).

P.O.J. 2878, a variety very highly resistant to mosaic has been found badly affected with mosaic at Cuttack, Gurdaspur and Lyallpur.

Control measures.

38. Monkeys in relation to agriculture in South India.

T. V. RAMAKRISHNA AYYAR, Coimbatore.

Among the various animals which levy their toll on the South Indian agriculturist, monkeys occupy a fairly important status in many areas of the province ; this is particularly the case in localities situated in the vicinity of hill ranges or along forest areas. Though the writer has very little experience of conditions outside this province they are probably similar in the neighbouring provinces also since we had newspaper reports of monkey trouble in places like Belgaum in the Bombay Presidency. Though in some countries outside India cases have been recorded of monkeys being trained in farms for useful items of work such as fruit picking, coconut gathering, scaring away other pests like crows, etc. etc., in India so far as the writer is aware, the monkey is only notorious for its injurious habits. Anyone visiting places of pilgrimage situated on hills like Tirupati, Palni, etc., can easily convince himself of the acts of mischief and the depredations caused by monkeys to pilgrims in various ways. In this paper an attempt is made to record the writer's experience with monkeys on his small farm and in some of its adjacent villages, all situated along the foot hills of the Western Ghats, in South Malabar. In this brief paper are included notes on the species of monkeys concerned, the nature and extent of injuries caused by them and some of the local methods adopted to get relief. The main idea of the paper is to get further information if possible from others interested in this subject.

Soils:

(A) Physics and Physical Chemistry

39. Some aspects of the 'Anion effect' in the interactions of sodium clays with sodium salts.

RAMPRASAD MITTRA, Calcutta.

The variations of the state of dispersion and cataphoretic velocities (c.v.) of colloidal solutions of sodium clay on the addition of NaCl, $NaNO_3$, $Na_2S_2O_3$, Na_2SO_4, $Na_2C_2O_4$, Na_3PO_4 and $Na_4Fe(CN)_6$ have been studied. For determinations of the c.v. the micro-cataphoretic method was used and the changes in the state of dispersion of the colloidal solution were followed with the aid of the Pulfrich photometer (Stupho Comparator). While NaCl, $NaNO_3$, $Na_2S_2O_3$ and Na_2SO_4 caused a coalescence at all concentrations a marked peptization and a collateral increase of c.v. were observed with $Na_2C_2O_4$, Na_3PO_4 and $Na_4Fe(CN)_6$. The peptization and the increase of c.v. were greater the higher the concentration of these salts. Using high concentrations the initial peptization was followed by a gradual aggregation of the particles during which time the c.v. continually increased. At low concentrations this time effect was absent. Sodium ferrocyanide had a marked inhibiting action on the coagulating power of barium chloride which further illustrates its strong peptizing effect. Preliminary work shows that this reagent is a good dispersing agent in the mechanical analysis of the soils so far examined.

40. Studies on the laterite and red soils of India, Part V. A preliminary description of the profile of a few of these soils.

A. T. SEN, Burma.

The profile of soils in some of the laterite areas in Peninsular, Central and Eastern India including Buchanan's laterite soils of Malabar has been examined. A distinction may be drawn between profiles developed under more or less dry weather with evenly distributed rainfall and those developed under alternating wet and dry periods. In the former case red loam seems to be formed as evidence of intense decomposition leading to complete separation of the sesquioxides is absent in the profile whereas in the latter case laterization appears to take place. The profile characteristics of laterite soils in India so far observed are: (i) disintegration and decomposition of rock and soil material to a considerable depth, (ii) light red colour of the soil material in the surface horizon. (iii) slightly acid reaction of the surface horizon passing into neutral or even slightly alkaline reaction in lower horizons, and (iv) a tendency to formation of honeycombed iron crust in the surface horizons.

(B) Chemistry

41. Analysis of the organic matter fraction of soils and of manures mixed with soil.

C. N. ACHARYA, Bangalore.

The present methods for determining the various fractions of soil organic matter, e.g., Waksman's are shown to be empirical and to yield results which carry no chemical significance. The methods which have been developed for the analysis of the structural constituents of plant materials e.g., cellulose, lignin, furfural yielding compounds, etc. are found to be not directly applicable to soils and materials containing soils.

The paper reports a procedure for overcoming the interference due to the presence of soil in the estimation of the following fractions of soil organic matter :—(i) Alcohol-Benzene extract, (ii) Uronic acids, (iii) Pentosans, (iv) Cellulose, and (v) Lignin.

Uronic acids are determined by treatment with 12% HCl and estimating the CO_2 evolved and making an allowance for the CO_2 evolved from carbonates present.

The total furfuraldehyde yield is obtained by steam distillation with 12% HCl in presence of stannous chloride according to the procedure outlined by the author for soils and subsequent precipitation with phloroglucinol. The pentosans are calculated after making an allowance for the furfuraldehyde evolved by the uronic acids present.

Cellulose is determined by alternate extraction of the soil with acid-hypochlorite and alkali-sodium sulphite till no brown colour is obtained on the addition of the latter reagent. The carbon content of the residual soil is determined and the cellulose calculated by multiplying with the factor 2·45.

Lignin is estimated by treatment with 72% H_2SO_4 for 15 hours at 15–20°C. and multiplying the residual carbon content with the factor 1·65.

The procedure has been found to yield satisfactory recoveries of added plant constituents. Analytical data for different types of soils and manures are given.

42. Comparison of methods for the estimation of furfural yield of soils and manures.

C. N. ACHARYA, Bangalore.

The present paper reports a comparison of the bromine titration method and the gravimetric phloroglucinol method for the estimation of the total furfural yield of soils and manures.

The kinetics of the furfural-bromine system have been examined and it has been shown that Powell and Whittaker's relationship, viz., 1 mol. of furfural = 4 atoms of bromine, at the end of one hour, is empirical and subject to variations due to temperature, concentration of reactants, etc. Powell and Whittakar's method, if carefully followed, gives results agreeing with the phloroglucinol method for plant materials.

In the case of soils and manures mixed with soil, however, low results are obtained by both the methods, due to the presence of oxidizing agents such as ferric and manganese compounds and nitrates in the soil, which apparently oxidize a portion of the furfural during the course of distillation with 12% HCl. The addition of stannous chloride, in regulated amounts, serves to reduce such oxidizing agents and yield the proper recovery of furfural.

In the presence of stannous chloride, however, appreciable amounts of hydroxy-methyl furfural are evolved which go to increase the ' apparent furfural ' yield as determined by bromine titration. In the case of phloroglucinol precipitation, the portion of the precipitate due to hydroxy-methyl-furfural can be separated by treatment with boiling alcohol in which it is soluble, and thus correct values corresponding to furfuraldehyde alone could be obtained.

Hence it is concluded that for the estimation of the furfural yield of soils and plant residues or organic manures in the presence of soils the $SnCl_2$—phloroglucinol method is preferable to the bromine titration method.

43. A study of the decomposition products of calcium cyanamide in relation to the lag-period during its nitrification in some Indian soils.

N. V. Joshi *and* H. D. Singh, New Delhi.

The mechanism of cyanamide decomposition in three Indian soils was studied with particular reference to the cause of the delay that occurs between the accumulation of ammoniacal nitrogen and its conversion into nitrates.

The following conclusions are drawn as a result of this investigation:—

Cyanamide is decomposed completely within about 3 weeks.

Dicyandiamide is formed from one week to three months according to the nature of the soil and contrary to the general belief is not toxic to nitrifying organisms in the concentration in which it is present in soils.

The delay in the oxidation of ammoniacal nitrogen is most probably connected with the water insoluble decomposition products of calcium cyanamide particularly the one which is extractable with 1% HCl.

Dicyandiamide, the most refractory of the water soluble compounds in the soils, is ultimately found to be converted into nitrates.

44. Effect of sunlight on the nitrification of ammonium sulphate and oil-cake in the soil. Part II.

D. V. Bal *and* R. S. Krishnamurty, Nagpur.

The observation recorded previously that no nitrification of added organic or ammoniacal nitrogen takes place in soils containing adequate moisture and exposed to sunlight, has been confirmed.

The process of ammonification in the soil, however, continues even when it is exposed to sunlight.

The absence of nitrification is not due to the death of the soil nitrifying organisms but is due to their temporary inactivity as a result of the unfavourable effects produced by sunlight. When soils previously exposed to sunlight are subsequently incubated in the dark, the nitrifying organisms slowly recover from the ill-effects of sunlight and begin to function in a normal manner.

In the case of soils receiving the lower dose of nitrogen, there was neither any appreciable loss nor gain in the total nitrogen content of the soils after they were incubated for a period of 27 weeks (15 weeks of partial sunlight and 12 weeks in the dark). In the case of soils receiving the higher dose, there was however a loss of nitrogen to the extent of 3 to 7 per cent. during the exposure of the soils to sunlight, but no further loss took place when they were subsequently incubated in the dark.

45. On the nature of red and black tropical soils.

S. P. Raychaudhuri, Dacca.

In tropical countries, red and black soils occur in neighbouring localities, under apparently the same geological and climatic conditions. From the point of view of soil genesis it is not easy to explain the mechanism of the formation of such soils. A detailed examination of the physico-chemical properties of such soil types at different layers of the profile is necessary. Such investigations were carried out at the Rothamsted Experimental Station with a number of typical soil profiles, kindly supplied by the authorities of the Makwapala and Domira Bay Cotton Stations of the Nyasaland Protectorate of Central Africa. Determinations were made of the silica-sesquioxide ratios and of the contents of free silica, free alumina and free iron oxide in the clay fractions. The base combining capacities, C/N ratios as also the general physical properties of the soils have been studied. The general conclusion drawn from the above experiments is that although it is not possible to offer an adequate interpretation of the origin of the contrasted soil types, it appears that the major differences are in the state of the organic matter and of the iron compounds. This may be produced by differences in the drainage conditions.

46. Usefulness of soil solution examination in plant nutrition problems.

H. N. MUKERJEE, Sabour.

(Through T. J. Mirchandani.)

The availability of plant nutrients from the soil, when it is treated with organic manures (F.Y.M. and Green manures) or is simply heated, is investigated by a detailed study of the soil—soil solution—plant system, for two crops, barley and paddy. Each treatment is judged by two tests of availability : (i) the amount of nutrients appearing in the soil solution, and (ii) the amount of nutrients removed by the crop, the former indicating the power of the soil complex to transfer nutrients to the soil solution, over any length of time, in face of the continuous withdrawal by the plant, and the latter showing the actual amount of nutrients that are available from the point of view of the plant. These taken together have given a complete picture of the whole growth process and provided a basis for the interpretation of the data that might be obtained in the future soil solution studies.

The soil solution was examined for organic nitrogen, ammonia, nitrate, phosphate, (organic and inorganic forms), potash and the analysis was done by the micro-chemical methods. The relationship of the concentration of the soil solution and the plant growth has been established.

The work was carried out at the Imperial College of Science, London.

(C) Micro-Biology

47. Cellulose decomposition by a new organism growing in association with other organisms commonly occurring in soils and manures.

N. V. JOSHI *and* S. C. BISWAS, New Delhi.

During the course of investigation of enrichment cultures made for studying cellulose decomposition from the following materials : (i) rotting paper, (ii) cowdung, (iii) leaf mould manure, (iv) soils from Pusa and Delhi, and (v) horse dung, it was found that the cultures made from single colonies capable of decomposing filter paper in nutrient solution were ‘ mixed cultures ’ developing into yellow or reddish colonies. Those mixed cultures would not yield pure cultures when grown on cellulose agar or ordinary agar, but starch agar could separate the mixed cultures into pure cultures which include one organism common to all, associated with either a ‘ yellow ’ or ‘ red ’ growth.

This organism common to all the mixed cultures decomposes cellulose only when growing in association with some other organisms commonly occurring in soils or manures. This peculiarity distinguishes it from other cellulose decomposing organisms.

The morphological, cultural and biochemical characteristics of the organism and the two other organisms associated with it, the products of their metabolism, and the quantitative dissolution of cellulose and nitrogen consumption as well as the nitrogen fixed by it in association with azotobacter, have been studied and described in the paper.

Manures and Fertilizers

48. Rôle of manganese in soil fertility.

C. R. Harihara Iyer *and* R. Rajagopalan, Bangalore.

Previous researches by the authors have shown that chemical oxidizers such as manganese dioxide or permanganate function indirectly as fertilizers in the soil. They hasten the decomposition of organic matter and increase the availability of plant food.

Recent studies have shown that even soluble salts of manganese, such as the sulphate, produce similar effects when applied in moderate quantities. It has been found that the soluble manganese soon passes into the insoluble condition and is present chiefly as the dioxide. The latter occurs in finely divided condition so that the treatment is in some respects even more potent than direct application of manganese dioxide.

These and relevant observations would show that although manganese salts may exert an ionic effect in culture solutions they behave very differently in the soil.

49. Dissolution of bone by fermentation of cane molasses.

T. R. Bhaskaran *and* S. C. Pillai, Bangalore.

Studies on the mechanism of dissolution of bone by fermentation with cane molasses have shown that the organic acids formed in the medium react with the insoluble phosphate in bone according to the equation :

$$Ca_3(PO_4)_2+4\times COOH \rightleftharpoons CaH_4(PO_4)_2+2Ca(\times COO)_2$$

Evidence has been adduced to show that the dissolved phosphorus exists in the medium in a water soluble condition.

The main factors that control the adoption of the above principle in the preparation of a water soluble phosphate fertilizer from bone have been studied. It has been shown that the percentage dissolution depends on (i) the particle size of the bone, (ii) the concentration of the acids formed in the medium, and (iii) the reversible nature of the reaction. The products of reaction of the acids with the tricalcium phosphate being largely water soluble does not permit a complete quantitative reaction in the forward direction.

The theoretical significance and the practical importance of the above observations have been discussed.

50. Production of the mixed calcium salts of organic acids from cane molasses for fixation of nitrogen in the soil.

T. R. Bhaskaran *and* S. C. Pillai, Bangalore.

Previous studies by the authors have shown that the products of decomposition of cane molasses—chiefly the mixed organic acids—when applied to soil serve as a highly potent energy material for fixing atmospheric nitrogen.

The factors that control the large scale conversion of molasses into these acid products have been studied. A simple method of conducting the fermentation has been described. The procedure consists in mixing molasses with soil and conducting the fermentation in pits under anærobic conditions. By the above procedure it has been possible to obtain a final product containing 10 per cent. organic carbon. The nitrogen fixed when the product is applied at the rate of 5 tons per acre would correspond to 2 cwts. of ammonium sulphate.

51. Experiments on the green manuring of soil with sanai (*Crotolaria juncea*) with its effect on the nitrogen and nitrate fluctuations of the soil and the yield and quality of the succeeding sugar-cane crop.

B. N. PRAMANIK, Shahjahanpur.

The paper deals with sanai as a manure for sugar-cane crop.

52. Studies in soil fertility.

A. L. SUNDAR RAO, Allahabad.

In the course of his experiments on the utilization of molasses as fertilizer the author made a systematic study of the physical and chemical properties of soils from fertile and infertile regions of the same tract in cane growing areas.

It was observed that the major chemical constituents did not differ much while the colloid content was different in the two types of samples. Absorption of water vapour was also markedly different at all the relative humidities at which experiments were done. An interesting fact was observed while studying the soil-water relationships viz., that the dehydration of soil colloids was partly irreversible. Soils subjected to alternate heating and wetting lose their powers of absorption of water vapour to a certain extent.

In view of the fact that the importance of trace elements like Mn, Ti, and Zn in promoting plant growth has generally been recognized, a new method of detecting and estimating these trace elements by the Spectrograph has been developed. The arc spectra of many representative soil samples were photographed and examined. Besides the elements which can be detected by chemical analysis as well, the trace elements Zn, Ti, Mn and B could be detected and identified, while Be is suspected in a few. The Mn content of the majority of fertile soils was found to range from 0·04 to 0·15 per cent. while the value of Zn ranged from 0·03 to 0·06 per cent.

53. Effect of growing berseem on the nitrogen level in the soil.

T. J. MIRCHANDANI, Sabour (Bihar).

Changes in the soil nitrogen as a result of growing berseem have been studied under the field conditions at Sabour, by analyzing the soil samples every month during the growth of the crop. The two years' work has shown that there is an increase in the soil nitrogen, corresponding to 150 lbs. of nitrogen per acre from October to January and then a gradual fall to almost original level in May. These changes are confined to the first foot, the lower layers were found to be unaffected.

The January sampling corresponds to the second cutting of berseem and the May one to the final (sixth) cutting. The results indicate that the fixation of nitrogen by berseem takes place up to the time of second cutting, after which the crop draws its nitrogen supply from the soil. Dr. Mackenzie Taylor reports similar results from Egypt.

The laboratory observations are supported by the results at the Kanke farm where the soil, after allowing berseem to seed, was so exhausted as to necessitate a manurial dressing in the ensuing season. It was also noticed that a dressing of niciphos to berseem after March produced an extra cut of fodder.

Berseem is finding a place in the general crop rotation in many parts of India but its value as an enricher of soil nitrogen is limited by the observations made in our investigation.

54. Plant-food requirements of calcareous soils, Part I. Optimum requirements of phosphorus for Pusa calcareous soils.

S. Das, New Delhi.

(Communicated by B. Viswa Nath.)

Both pot and field experiments carried out with basal dressings of nitrogen and potash showed that the application of 60, 70 and 80 lbs. of P_2O_5 per acre as precipitated calcium phosphate yields the maximum crop production of oats, *ragi* (*Eleusine coracana*) and mustard respectively in calcareous soils and meets the optimum phosphate requirements of these soils for the above crops.

The results obtained were statistically tested and found to be highly significant.

The examination of available phosphoric acid of the soil samples to which were added increasing doses of P_2O_5 as precipitated calcium phosphate varying from 25 to 400 lbs. per acre, showed that the values obtained with the author's potassium carbonate method were significantly related to the crop yields of *ragi* up to the limit of 75 lbs. of P_2O_5 per acre. Hence 0·0051 per cent. of available phosphoric acid of a calcareous soil resulting from the application of 75 lbs. of P_2O_5 per acre corresponds to the maximum crop production.

On the other hand, the values of available phosphoric acid obtained with the Dyer's citric acid method did not yield such significant results as above and failed to corroborate the crop yields.

The examination of the mechanism of assimilation of important food materials by the growing crop from the soil and the fertilizers applied showed that the P_2O_5 content of the *ragi* grain increases appreciably with the increasing phosphatic treatment, while the nitrogen content remains almost steady. Its potash content does not, however, show any appreciable variation.

55. Responses of sugar-cane to different nitrogenous manures.

P. V. Ramiah *and* T. Varahulu, Coimbatore.

The influence of castor cake, farm yard manure, ammonium sulphate and groundnut cake on two cane varieties, Co. 213 and Co. 421 was studied in pot cultures. The indications are : (i) that castor cake and farm yard manure appear to increase the number of tillers and to hasten their formation ; (ii) that ammonium sulphate delays tiller formation ; (iii) that for every variety there appears to be a minimum vegetative growth, before the attainment of which, no tillers would appear, and the magnitude of this minimum varies with treatment, and (iv) that the primary shoot and its tillers exercise a mutual adverse influence on each other's growth. This indicates the desirability of removing the superfluous and late formed tillers, so as to avoid the presence at harvest of canes of widely varying degrees of maturity. Manuring with castor cake and farmyard manure helps to this end. Field scale experiments are proposed to be carried out to verify these indications.

56. Value of manuring sugar-canes in Assam.

L. N. Phukan, Assam.

A combined varietal and manurial experiment with three varieties viz., POj. 2714, Co. 213 and Teli (a local cane) and three manure treatments viz., no manure, 125 mds. cowdung and 250 mds. cowdung, per acre was conducted for two years both in plant and ratoon canes.

In the plant canes, POJ. 2714 and Co. 213 behaved similarly and were distinctly superior to Teli. The yield of crop increased almost proportionately to the increasing doses of manure.

In the ratoons, Teli was found to be distinctly inferior to POJ. 2714 and Co. 213, as before. Without further manuring, POJ. 2714 and Co. 213 behaved similarly as they did in plant canes but with increasing applications of cowdung, Co. 213 gave significantly higher yields than POJ. 2714. The residual effect of manures was also more prominent with Co. 213 than with POJ. 2714.

The experiment clearly indicated that Co. 213 was more suitable to poor soils and to cultivators who are unable to manure their crop adequately.

POJ. 2714 possesses a higher sucrose content but requires more manuring and is suitable to rich virgin soils and intensive cultivation.

The necessity for manuring the sugar-cane crop is clearly shown whereby the normal yield of the crop in the province can be considerably increased.

SECTION OF MEDICAL RESEARCH

President:—SIR U. N. BRAHMACHARI, KT., M.A., M.D., PH.D., F.N.I., F.R.A.S.B.

1. Acridin X in the treatment of monkey malaria.

H. E. SHORTT *and* K. PADMANABHA MENON, Guindy.

An antimalarial drug said to be 'akin to atebrin' was submitted to us by Sir Upendranath Brahmachari for clinical trial in monkey malaria.

A series of experiments was carried out on monkeys infected with *Plasmodium knowlesi* comparing the action of the drug with that of atebrin for injection.

The effect in sterilizing the peripheral blood, the cure rate, and relapse rate of the two drugs were compared.

The results of the experiments showed the two drugs to be identical in their action on *P. knowlesi* and the presumption is that acridin X, if not identical with atebrin, is derived from the same base.

2. Treatment of blackwater fever.

K. V. KRISHNAN *and* N. G. PAI, Calcutta.

The work of Krishnan and Pai on monkey hæmoglobinuria had suggested that at least three conditions have to be satisfied before hæmoglobinuria can occur, namely, a lowering of free-cholesterol, a damage to the liver, adrenals and reticulo-endothelial system and an excessive production of unsaturated fatty acids. On the basis of this theory attempts were made to correct these changes if possible and see how far they influenced the incidence of hæmoglobinuria. Fairly satisfactory results were obtained in monkeys through treatment with a combination of glucose, ascorbic acid and cortin. A combination of choline hydrochloride and quinine also gave encouraging results. It is suggested that these may be of value in the treatment of human blackwater fever. A few preliminary trials have given encouraging results.

3. The evolution of and the present position regarding the treatment of hookworm infection.

P. A. MAPLESTONE, Calcutta.

A general discussion is given on the drugs of use in treating hookworm infection, and the history of their introduction is outlined.

The methods of estimating the efficiency of drugs in treating this condition are considered.

The recognized drugs are compared from various points of view, such as efficiency, toxicity, ease in dispensing and price, and the conclusion is reached that tetrachlorethylene is the best if all the above points are taken into consideration.

4. A note on the treatment of epidemic dropsy by a stock vaccine containing an organism isolated from the stool.

C. C. BASU *and* ANIL CHAUDHURI, Calcutta.

The paper deals with epidemic dropsy cases treated with vaccine containing a non-lactose fermenter. The organism was isolated from stool and found to be pathogenic to animals.

The authors report that vaccine treatment with organisms of the salmonella group gives encouraging results in epidemic dropsy cases.

5. Treatment of filarial lymphangitis.

S. Sundar Rao, Calcutta.

Filarial lymphangitis is a common manifestation of filarial infection in endemic areas and is caused in most cases by secondary infection. In its mildest form the inflammation does not last for more than 2 to 3 days and does not generally call for any treatment. When the attack is more severe it causes acute suffering and in some cases ends fatally. A number of drugs such as carbonactyl, proseptasine and soluseptasine and prontosil have been tried in these cases and the results are reported. The effect of anti-streptococcal serum treatment is also discussed.

6. Effect of malarial toxin on filarial infection.

S. Sundar Rao, Calcutta.

Observations on artificially induced malaria of both human and monkey strains on filarial patients have been made and the results are discussed. A decrease in the microfilaria-count is noticed immediately after the malarial infection develops in the system but the effect is only temporary. The microfilaria-count reaches its original level as soon as the malarial infection dies out. The significance of the results with respect to the presence of both malarial and filalrial infections in this country is discussed.

7. Chemo-therapeutic study on streptococcal infections.

S. P. De *and* U. Basu, Calcutta.

p-amino-benzene-sulphonamide is usually administered in large doses, which is often difficult and sometimes leads to toxic effects. For this, several derivatives of the type, $NH_2 . C_6H_4 . SO_2$ NHR, R = 8-quinonyl, 6-methoxy-8-quinonyl, δ-diethylamino-butylamine and *p*-anisyl, have been prepared and their actions on mice infected with a particular dose of streptococcus hæmolyticus have been studied. But no compound is found to possess a better bactericidal property. The first two derivatives are too toxic, whereas the butylamine derivative has no specific action even *in vitro*. Their acetyl derivatives are less efficacious. This with the observation of Marshall that sulphonamide is partly converted *in vivo* to acetyl derivative possessing a lesser activity indicates that to be an ideal drug, the compound must be R NH . $C_6H_4 . SO_2$ R^1, where R would not lower down the efficacy of the drug and R^1 would help the compound to exert its full therapeutic effect.

8. Chemical constitution and hæmostatic action of coumarins.

P. K. Bose, P. B. Sen, *and* K. Chakraverty, Calcutta.

A number of synthetic compounds allied to ayapanin (7-methoxy-coumarin) and ayapin (6 : 7-methylene dioxycoumarin) have been prepared and their effects on the clotting time of blood have been observed. The replacement of methoxy group of 7-methoxy-coumarin by higher alkoxy groups diminishes or completely suppresses the hæmostatic action. Aesculetin dimethyl ether is active but not scopolin. Many other natural coumarins, such as psoralin, angelecin, imperatorin (marmelosin), xanthotoxin, etc. have been found to be devoid of any hæmostatic properties. Ayapanin and ayapin have great possibilities as hæmostatics.

9. Some recent observations on the protective value of plague vaccines.

S. S. Sokhey, Bombay.

Using the standardized quantitative methods recently described by the author for measuring the virulence of strains of *Past. pestis* and for measuring the protective value of plague vaccines further observations have been made. Protective value of broth and agar vaccines has been compared. The effect of temperature of incubation of plague cultures and the effect of temperature of killing cultures on the resultant vaccines have been measured. Heat-killed vaccines made from virulent strains have been compared with live vaccines made from non-virulent strains.

10. A new antiplague serum.

S. S. Sokhey, Bombay.

The preparation of a new antiplague serum is described. New laboratory tests for measuring the value of an antiplague serum have been developed and the results of the animal tests are presented.

11. A new antityphoid serum.

H. Ghosh, S. K. Bose, *and* S. M. Mukherji, Calcutta.

An antityphoid serum was obtained from horses immunised with a toxin prepared by culturing *Bact. typhosus* anærobically in highly alkaline broth. It was found that the serum thus obtained has got a very high agglutinating titre (1 in 8000) presumably due to the presence of a large number of autolyzed bacteria in the toxin. Antityphoid serum was also prepared by injecting typhoid bacillus grown on solid agar. Protection test showed that the serum obtained by immunization with filtered toxin could protect the animal against 3 to 4 minimum lethal doses while the serum prepared with simple typhoid vaccine could hardly protect the animal against 2 minimum lethal doses.

Six cases were so far treated with this antityphoid serum. In the case notes are shown the result of treatment by serum. Only one intraperitoneal injection of 75 c.c. of the serum diluted with 200 c.c. of sterile normal saline was given in each case. In all cases the serum was given on the 10th or 11th day of illness and the temperature became normal on the 16th or 17th day. Toxæmia disappeared entirely after serum injection in each case.

12. The applicability of collapse-therapy at the out-patients' section of a city hospital.

A. C. Ukil *and* K. N. De, Calcutta.

An attempt has been made to estimate the effect and the possibilities of relaxation-therapy in pulmonary tuberculosis as carried on in the out-patients' department of a city hospital. From July 1931 to June 1937 nearly 1,000 cases had undergone artificial pneumothorax, 250 cases phrenic evulsion and 3 cases thoracoplasty.

The paper discusses the difficulties of treating these ambulatory cases and keeping them under control. It has been observed that a fair measure of improvement has been obtained in advanced bilateral cases.

A statistical comparison has been made with the results obtained by sanatorium treatment and it has been observed that nearly 70% of the cases thus treated, showed positive results. Under the circumstances, a plea is made that district hospitals and similar well-equipped institutions may introduce the modern methods of diagnosis, treatment and follow-up for cases in semi rural and rural areas.

13. Herpes Zoster. Experiments with tissue lysate as a therapeutic agent.

L. M. GHOSH, Calcutta.

Forty cases of herpes zoster have been treated with intradermal injections of tissue lysate prepared from the herpetic vesicles and the results have been uniformly successful in relieving the pain and cutting down the duration of the disease. The technique of preparation of tissue lysate is simple and it would be possible to prepare it on a commercial scale.

14. Malaria treatment and its effects on the histopathology of the brain in general paralysis of insane.

C. C. SAHA, Calcutta.

The pathological findings in general paralysis of insane (not treated by malaria)—compensatory hydrocephalus, pachymeningitis hæmorrhagica, decortication, frosting of the floor of fourth ventricle, leptomeningitis and perivascular cuffing showing deposit of lymphocytes and plasma cells, degeneration and disappearance of cells of cerebral cortex, presence of spirochætes and paralyse-iron, focal demyelination, neuroglial proliferation and conversion of microglia to rod cells have been described.

Treatment of general paralysis of insane is described with special reference to pyrotherapy specially the malaria inoculation. Modes of infection, course of the infection and its care, dangers, contraindications, results of treatment and its mode of action are also described.

The changes found in the brain after malaria treatment have been described with special reference to the absence of spirochætes and the absence of iron particles.

The possibility of a correlation between these two factors, namely, whether the presence of iron particles is due to the slight continuous hæmolytic activity of spirochætes—direct as in cases of paroxysmal hæmoglobinuria or indirect as in cases of hæmolytic jaundice is discussed.

15. Neuro-dermatitis.

G. PANJA, Calcutta.

Clinical features of the disease, its diagnosis, prognosis and treatment are discussed, and a new idea as to its pathogenesis is advanced.

16. Allylisothiocyanate in relation to epidemic dropsy.

R. B. LAL *and* S. C. ROY, Calcutta.

(Indian Research Fund Association.)

The authors' previous studies on the ætiology of epidemic dropsy have pointed towards the conclusion that the disease as commonly met with in epidemic form in Bengal, Bihar, and Assam was caused by the ingestion of an unknown poisonous substance, conveyed through the agency of mustard oil.

The problem was approached from three aspects : (1) The loss of allylisothiocyanate suffered by oil in the process of cooking or otherwise heating the oil whether present naturally or added artificially. It was found that ninety per cent. or more of the essential oil was lost. (2) The effects of large doses of allylisothiocyanate, mixed with oil, on laboratory animals. No symptoms resembling epidemic dropsy were produced by this means. (3) A comparison of the allylisothiocyanate content of the oil used in human experiments and that used by certain families in which no ill effects were observed. The results suggested that the oil associated with epidemic dropsy was not particularly rich in the essential oil. The authors are unable to support the view that allylisothiocyanate was the factor responsible for producing symptoms resembling epidemic dropsy.

17. Coronary occlusion.

J. N. Maitra, Calcutta.

18. Allergic diseases and the method of preparing extracts for their diagnosis and treatment.

C. A. Rothenheim, Bombay.

The paper describes various allergic diseases. Diabetes and allergic disease combined in the history of a family are communicated. The manufacturing of allergic extracts for diagnosis and therapy is thoroughly described.

19. Observations on scorpion-sting and snake-bite.

U. P. Basu, Calcutta.

The author observes that no death is reported from scorpion-sting in India. He reports 19 cases of scorpion-stings admitted into Calcutta Medical College Hospitals from 1928 to 1937, of which 13 were children below 10 years of age, the mortality being 38·5%. During the same period 27 cases of snake-bite were also admitted between 12 to 45 years of age, twenty of which were viperine and five colubrine. The death-rate was 60%. Comparatively lesser number of admissions of scorpion-stings among adults was due to less severe symptoms in the adults than in children.

Snake-bites manifested classical symptoms of the two types. Scorpion-bites had excruciating pains immediately and some hours following bite and manifested allergic symptoms of headache, giddiness, nausea, vomiting, profuse perspiration with chill, followed often by unconsciousness. The extremities were cold, temperature subnormal, pulse feeble and fluttering, heart sounds muffled. There was fever in some cases. In fatal cases respiration was hurried and majority died from œdema of the lungs. Scorpion was identified to belong to Buthidæ family, Species Tamulus.

In snake-bites local infiltration with gold chloride and Kasauli antivenene intravenously were given. The poisons of different kinds of scorpions differ quantitatively and qualitatively. The present-day treatment of poisons of scorpion-sting and snake-bite is unsatisfactory. The author suggests preparation in India of anti-scorpion serum like 'Todd's Egyptian scorpion serum' and a better form of treatment for snake-bite.

20. Study of electrocardiographic tracings of fifty cases of epidemic dropsy.

P. Ganguli, Calcutta.

Electrocardiographic studies of 50 cases of epidemic dropsy show certain interesting variations from normal curves, the most important being that of T waves in the third lead.

21. The absence of effective immunity after cure of protozoal infections.

H. E. Shortt, S. R. Pandit, K. P. Menon, *and* C. S. Swaminath, Guindy.

The opinion of protozoologists is coming more and more towards the conception that the mechanisms of immunity against protozoal infections are essentially the same as those brought into action against bacterial invasions.

The object of the present investigation was to determine whether the relative immunity (premunition) present in chronic or low grade infections with protozoa would disappear completely with parasitic sterilization of the host.

The protozoa experimented with were *Babesia canis*, the cause of tick fever of dogs, *Plasmodium knowlesi* and *Plasmodium cynomolgi*, parasites of monkey malaria.

The plan followed in the experiments was to infect animals with these various parasites, allow some to develop chronic or latent infections and cure the remainder to the degree of complete parasitic sterilization.

The chronically infected animals and those which had been cured were then inoculated with homologous strains of the parasites originally used to infect them and the results compared.

In general it was found that animals carrying latent or chronic infections with the protozoal parasites being investigated were immune to super-infection. On the other hand those which had been cured to complete parasitic sterility had little or no residual immunity and were as susceptible to reinfection as normal animals.

22. The rôle of antibodies in kala-azar.

K. V. Krishnan, Calcutta.

An investigation was conducted to find out whether the presence of specific antibodies to *L. donovani* was capable of modifying the course of leishmania infection in mice and if so what part these antibodies played in the mechanism of cure and resistance to the infection. The results indicate (1) that antibodies are formed both as a result of inoculation of leishmania vaccine as well as during the course of infection; (2) that antibodies are capable of lysing extra-cellular leishmania *in vitro* and possibly also *in vivo* but not intracellular leishmania; (3) that as leishmania are present intracellularly in the body of the host, antibodies fail to destroy them until the host cells are destroyed and the parasites are liberated; (4) that the evidence suggests that specific antibodies are of some importance in overcoming infection but they do not explain the whole process of immunity and cure in kala-azar.

23. Chemical and serological variation in single-cell cultures of *Vibrio choleræ* and related organisms.

R. W. Linton *and* S. C. Seal, Calcutta.

(Indian Research Fund Association.)

In continuation of previous work on variation in the vibrios the authors have now made a study of single cell cultures. Beginning with a strain having certain cultural, biochemical and serological characteristics and a certain chemical structure, they have shown that it is possible to produce from it a strain having entirely different characteristics and a different chemical structure. The new strain falls into a different chemical group from the old and its characteristics are those of the new group *in toto*. In other words, the changes which take place are correlated and not haphazard

While variation in chemical structure appears to be fairly frequent in the vibrios, it is to be emphasized that the organisms in variation always *remain within the framework of two proteins and three polysaccharides*, which are common to the vibrio group as a whole. The conception is that of a strictly limited power of transformation.

Since in the present experiments all the organisms in a given strain were descendants of a single cell, it is suggested that the variants which arose were the result of changes in enzymatic activity within the cells themselves, leading to variations in synthesis of the cellular constituents, and thus to changes in the structure, and in the biochemical, serological and cultural characteristics of the strain as a whole.

24. Protein fractions of œdema fluids in epidemic dropsy.

R. N. CHOPRA *and* S. N. MUKHERJEE, Calcutta.

The protein concentration in œdema fluids in epidemic dropsy is not high but it is sufficient to confirm the damage of capillary permeability (as concluded from other experiments) in the light of the findings of Salvesen and Linder and Goværts. Both albumin and globulin escape from blood into tissues due to the increased permeability of capillaries, but albumin comes out in greater amount. The globulin to albumin ratio is remarkably constant in the œdema fluid showing thereby that a proportionate amount of globulin always comes out along with albumin. The slightly higher value of this ratio compared to that of aqueous humor in epidemic dropsy glaucoma can be explained. The amount of albumin in œdema fluid cannot account for the loss of albumin from the plasma. It therefore seems probable that albumin becomes depleted in epidemic dropsy by its toxin.

25. Adsorption of antigens by antibodies or *vice versa*.

B. N. GHOSH *and* N. N. RAY, Calcutta.

It has been reported by several workers that diphtheria antitoxin concentrated by precipitation with sodium sulphate, does not give flocculation test when mixed with an equivalent amount of diphtheria toxin. This problem has been investigated and a method has been evolved by which such concentrated antitoxin can be made to flocculate. when mixed with an equivalent quantity of toxin in presence of electrolytes. The rate of flocculation of concentrated tetanus and diphtheria antitoxins by their respective toxins at different *p*H has also been investigated. It has been found, that the rate of flocculation is the quickest for the diphtheria toxin-antitoxin mixture between *p*H 6·0 and *p*H 8·0 and for the tetanus toxin-antitoxin mixture between *p*H 5·3 and *p*H 7·2, while above *p*H 10·0 none of these toxin-antitoxin mixtures flocculate.

26. The Danysz phenomenon in staphylococcus toxin-antitoxin reaction.

B. N. GHOSH *and* N. N. RAY, Calcutta.

The Danysz phenomenon in staphylococcal toxin-antitoxin reaction has been investigated and it has been found that when the toxin is added to an equivalent quantity of the antitoxin in *two or more* instalments the resulting mixture is highly toxic as measured by its dermo-necrotic as well as, its hæmolytic effects; on the other hand if the antitoxin is added to the equivalent quantity of the toxin in several instalments, the mixture is non-toxic. It has been further observed that when the resulting mixture is toxic, the toxicity remains unaltered even twenty-four hours after the addition of the last portion of the toxin.

27. The chemical nature of tetanus toxin.

D. C. LAHIRI, Calcutta.

The possible nature of tetanus-toxin broth was investigated. The lines of approach were: to study the effect of tryptic digestion on the toxicity and antigenicity of the toxin broth; to extract some chemical fractions from it and to study their toxicity and antigenicity; to attempt to grow *Clostridium tetani* in protein-free synthetic medium and to test the toxicity and chemical nature of the filtrate.

The results were: There was no astounding difference in toxicity and antitoxin production between the digested and the undigested control. No antitoxin was formed from the parenteral administration of various chemical fractions in the rabbits, and they were completely atoxic. Failure of growth in protein-free (amino-acids as well) synthetic media was noted.

Giving due allowance to the difficulties in investigation due to the presence of ' broth ' molecules in inseparable conjunction with the ' toxin ' molecules the plausible conclusions are—

that the tetanus toxin molecule is not of the nature of a simple protein at least not that protein, which is digestible with trypsin; that the tetanus toxin molecule does not bear a split by the processes of extraction tried in the experiment mentioned, as it loses its properties thereby.

28. The effect of seitz-filtration on hemolysins and the components of a hemolytic system.

A. C. ROY, Calcutta.

Seitz filter is extensively used for effecting the filtration and simultaneous sterilization of solutions, culture media and other fluids, where the more drastic methods of sterilization requiring application of heat such as autoclaving, etc. cannot be resorted to. This filter while very effective in producing sterilization in a general way has certain serious limitations. It has been found that dilute solutions of saponins lose their hemolytic property when passed through Seitz filter. Bacterial hemolysins (cholera and streptococcus) are similarly affected. Diluted guinea-pig complement and anti-sheep amboceptor are inactivated by this process of filtration. Concentrated solutions of the active substances are comparatively unaffected. The use of the Seitz filter in investigations relating to bacterial toxins and when dealing with dilute solution is discouraged.

29. Observations on differentiating *Bact. coli* and *Bact. aerogenes* types of organisms on Levine's simplified eosin-methylene blue agar as applied to bacteriology of waters in Bengal.

SUKUMAR NEOGI, Khulna.

The author has reviewed the relative significance of the common types of lactose fermenting bacteria found in tropical waters with special reference to the intermediate types.

Levine's modified eosin-methylene blue agar had been employed with a view to differentiating *Bact. coli* and *Bact. aerogenes* simultaneously for confirming the ' presumptive coli ' by inspection of colonies on the plates. 966 colonies were tested by this way and the results showed that the differences between these two types of colonies could often be made out after incubation for 48 hours, but the lesser significant intermediate types could not always be eliminated. Out of 642 colonies, tentatively regarded as *Bact. coli* from their appearances on the agar, 483 colonies (75 2%) could be confirmed as such by differential tests and 22·6% was found to be of intermediate types and 3·2% was of *Bact. aerogenes* types. Out of 324 colonies tentatively regarded as *Bact. aerogenes* 231 colonies

(70·0%) could be confirmed as *Bact. aerogenes* types and 70 colonies (21·0%) were of intermediate types.

30. Experiments on the spirillum of rat-bite fever.

B. M. DAS GUPTA, Calcutta.

Experimental rat-bite disease has been studied in man and laboratory animals. Litters born of infected mice have proved negative for spirilla nor did they show any evidence of immunity to infection with the disease. Infection could not be produced in mice by feeding them on urine of infected animals or food contaminated with it for weeks. Adult mice of opposite sex were caged together, the male harbouring the specific parasite. Neither the female nor its offspring was found infected in spite of repeated and careful examinations.

Experimentally infected human volunteers gave consistently negative Wassermann reaction but guinea-pigs infected from these individuals showed positive reaction.

A comparative study on the prevalence of the spirilla in the blood and peritoneal fluid of the infected mice showed that the number of the spirilla in the latter did not diminish to an appreciable extent till the animal died of the disease or of some intercurrent infection; whereas it was subject to marked fluctuation from day to day in the blood from which the spirilla might even temporarily disappear altogether. An attack of experimentally induced rat-bite fever in man proved absolutely refractory to further infection.

31. The relation of the parasitic worms of lower animals to those of man, with special reference to fluke infestation.

G. D. BHALERAO, Muktesar.

The paper deals with the trematode infection of man in India and its occurrence in lower vertebrates. It points out the possibility of detecting several hitherto unknown infestations of man in India. The possibility is indicated of dermatitis occurring in man by the schistosome and the stylet-cercaria. Reference is made to the enormous loss suffered by man on account of the fluke infestation of the domestic animals.

32. The viability of certain pathogenic micro-organisms in various fresh fruits of India. The viability of *V. choleræ* in water-melon (*Citrullus vulgaris*, Schrad., Tarbuz).

F. R. BHARUCHA *and* K. H. BHARUCHA, Bombay.

The coincidence of epidemic diseases with certain fruit seasons in India and elsewhere led the authors to investigate whether Indian fruits could act as carriers of infectious diseases. With this aim in view *V. choleræ* was experimented with on the water-melon. The investigations so far carried out and confirmed over two seasons show that *V. choleræ* can live in the water-melon under experimental conditions as long as four days. The results show that the water-melon may act as a carrier of cholera under Indian bazar conditions.

33. Investigation on the bacterial flora of dahi (Yagourt) and the study of inhibitory influence of the different strains of lactic acid bacilli on *Streptococcus*, *Staphylococcus* and *Bact. coli*.

H. GHOSH, S. M. MUKHERJI, *and* S. K. BOSE, Calcutta.

Forty-two samples of dahi from different parts of Calcutta were examined. Various types of lactic acid bacilli were isolated. Pleomorphism of these strains of lactic acid bacillus was a very predominant feature. Sometimes bacillary form became coccoid. *Staphylococcus* and *Bact. coli* were isolated along with lactic acid bacilli from many samples of Dahi. Inhibitory influence of these strains upon secondary organisms such as *Bact. coli*, *Staphylococcus* and *Streptococcus* was observed. Most of the strains did not inhibit the growth of these secondary pathogenic organisms. A few of the strains had decidedly inhibitory influence on *Staphylococcus*, *Streptococcus* and *Bact. coli*.

34. Studies in filariasis in India.

M. O. T. IYENGAR, Calcutta.

Present knowledge of the distribution of filarial disease and of filarial infection in India is meagre. The relations of the two types of filarial infection, namely, *Wuchereria bancrofti* and *Filaria malayi* to the causation of filarial disease are discussed. The paper also deals with life histories of the transmitting mosquitoes, the factors which control filarial endemicity and methods of control.

35. Distribution of filarial infection in Calcutta.

S. SUNDAR RAO, Calcutta.

Intensive survey of filarial infection in the various wards of Calcutta and suburbs has been carried out. Various factors of infection are discussed in relation to the actual rate of infection found in the different wards. The wards lying on the eastern border of Calcutta are the most heavily infected. The infection is moderate in the wards adjoining the Hooghly river and Central Calcutta. The disease-rate is much higher and the relation between the microfilaria-rate and the disease-rate found in other areas does not hold good. The results of the mosquito survey of different wards are discussed in relation to the prevention of the infection.

36. Blood changes in filarial infection.

S. SUNDAR RAO, Calcutta.

Microfilaria rate in cases of elephantiasis is generally very low. The reasons for the disappearance of the embryos from the peripheral circulation in such cases are not clearly understood. The block of the lymphatics in persons with elephantiasis can only partially explain the absence of microfilariæ, as all the lymphatics are not blocked. It is suggested that antibody develops in cases of lymphangitis as a result of destruction of embryos and adult parasites; also as a result of secondary infection. It is possible that changes in the constituents of blood in the affected persons are adverse to the life of filarial worms.

37. Study of the Eijkman's test and modification as given by coliform organisms isolated from human fæces.

R. BANERJEA *and* A. K. SEN, Calcutta.

A large percentage of citrate-negative organisms isolated from human fæces fail to give a positive Eijkman's test as carried out with single strength Eijkman's medium.

Double strength McConkey broth seeded with the same organisms and incubated at 44°C. gave a larger number of positive results. Single strength broth however proved unsatisfactory for the purpose of the test.

38. Response of the chorio-allantoic membrane of the developing chick embryo to inoculation with various substances, with special reference to *B. proteus* X_{19}.

C. G. PANDIT, R. SANJIVA RAO, *and* H. E. SHORTT, Guindy.

The chorio-allantoic membrane culture technique has been used extensively for the cultivation of filtrable viruses. With some known viruses the interpretation of the results obtained presents no great difficulty but, in dealing with material containing a hypothetical virus, much caution is needed in interpreting the results obtained by this technique. Thus, it has been shown that physical and mechanical injuries may also produce appearances not greatly dissimilar to those which are known to be the product of virus infection. It has even been claimed that such lesions may sometimes be noted in uninoculated eggs. In this connection it may be stated that the authors have themselves isolated bacilli both from the chorio-allantoic membrane and from the heart-blood of chick embryos in uninoculated eggs.

Under these circumstances it was considered essential to study the response of the chorio-allantoic membrane to various substances definitely known not to contain any virus.

The substances employed in this study belonged to very varying categories. There were insoluble substances such as keisulguhr, Indian ink, and aluminium gel; soluble substances such as copper sulphate, sodium chloride, glycerine and starch; species of bacteria and bacterial filtrates, normal and febrile sera, milk, snake venoms, etc. It was found that of the inert substances aluminium gel alone produced lesions. Bacteria, on the other hand, produced lesions not unlike those of virus infections. An attempt has been made to classify these lesions on a histological basis. In a study of lesions produced by bacteria it was noted that with some, e.g. *B. proteus* X_{19} and *B. typhosus* the lesions produced could be passaged in series by filtrates of the ground lesions obtained through gradocol membranes of $0{\cdot}7\mu$ average pore diameter. The significance of this finding is discussed.

39. Occult hæmolytic streptococcal infection as portrayed by antistreptolysin titration.

E. H. KOERNER *and* E. P. POULTON, London.

The term 'occult infection' may be used where there is evidence that an organism is associated with a disease; but cannot be cultivated except sometimes in the early stages, e.g. streptococcal tonsillitis. Antistreptolysin titration devised by E. W. Todd and other immunity reactions suggest that acute rheumatism is an occult hæmolytic disease and the same applies to rheumatoid arthritis; we have found that there is a raised titre in about ¾ of long-standing rheumatoid cases in a municipal hospital. By using this method in a number of cases of uncertain ætiology the portrayal of 'occult hæmolytic infection' has been attempted. The cases may be grouped according to their most striking manifestation: (1) continued pyrexia, marked or slight, without rheumatic pains and not always after streptococcal sore throat; (2) Erythema nodosum—about half the number tested, the others being due to 'occult tuberculosis'; (3) Purpura (all the 8 cases tested) thrombocytopenic, rheumatic and Henoch's—two associated with acute nephritis; (4) Acute nephritis, 4 or possibly 5 out of 7 cases; (5) complicating other diseases—actinomycosis (1); migratory type 4 pneumococcal pneumonia (1); phthisis and anæmia (1).

40. A pathogenic strain of *Staphylococcus citreus* isolated from a case of osteomyelitis.

G. PANJA, Calcutta.

41. Possibility of identification of extracellular toxin of pathogenic micro-organisms by alum.

H. GHOSH *and* S. K. BOSE, Calcutta.

In the course of super-immunization by alum-precipitated toxoid of diphtheria and tetanus the authors observed that the volume of precipitate obtained after addition of alum varied with different samples of toxin. It was also noticed that there was a distinct relationship between the toxicity and the volume of the alum precipitate, i.e. if the toxicity was lower the volume of precipitate was smaller. The experiment was repeated with broth culture filtrate of different pathogenic micro-organisms. It was found that pathogenic micro-organisms, which are supposed to contain only endotoxin, produced very little precipitate with alum. Changing the hydrogen ion concentration did not affect the volume of the precipitate by alum perceptibly. On the other hand, copious precipitate was obtained from filtrate of broth culture of micro-organisms known to produce extra-cellular toxins such as diphtheria and tetanus.

42. Some factors controlling the activity of bacteriophage and the method and apparatus for filling medicinal phials with bacteriophage suspension as practised in the Bacteriophage Laboratory, Government of Bihar.

S. K. CHATTERJEE *and* L. R. N. S. DEO, Patna.

Ch.ψA is the most virulent of all the choleraphages. It is found in the stool filtrate of the majority of the cholera convalescents and is mainly responsible in bringing about a cure. The range of action of the phage should be increased by the process of adaptation. Phage should be administered to the cholera patients as early as possible. Massive dose system gives better result than small dose. In cholera epidemics where Ch.ψA does not act on the causative vibrio, phage treatment is likely to be a failure. After adaptation of Ch.ψA the use of the new phage checks the epidemic at once. Good results of choleraphage treatment in Bihar is mainly due to its rich Ch.ψA content and to the massive dose system.

The method and apparatus for filling ordinary medicinal phials with bacteriophage suspensions as practised in the Bacteriophage Laboratory, Government of Bihar are discussed.

In the authors' process the liquid is filled into the rubber stoppered phials by passing directly into the sterilized drum through filter candles which have been sterilized in the same operation as the drum and its contents (phials).

43. Prophylactic value of choleraphage.

A. N. CHATTERJI, Patna.

In two districts of Muzaffarpur and Purnea in North Bihar choleraphage has been exclusively used for seven years in succession from 1931. During this time which covers the period of a normal cholera epidemic wave in North Bihar, the wells and other sources of drinking water supply were not disinfected and hardly a person was inoculated with anti-cholera vaccine when cholera broke out in the two districts. There has been a remarkable reduction in the quinquennial average cholera death-rate per

1,000 of population during 1931–35 when the districts were treated with choleraphage alone, compared to the previous five-yearly averages from 1900 to 1930.

44. Studies of meningococcus bacteriophage.

B. B. SEN, Calcutta.

Meningococcus phage, when kept for one year in contact with serum, i.e. when prepared in media containing serum, does not seem to be deteriorated in action. Action of meningococcus phage is retarded *in vitro* at and above the incubation temperature, though the phage does not die at that temperature. It appears that the meningococcus bacteriophage dies at and above the temperature of 60°C., and that its action is retarded or inhibited *in vitro* at and above the incubation temperature, when it is kept in contact with the living cultures. Thirteen lysable strains were studied. Clinical results tend to show that *in vivo*. the meningococcus phage can grow and produce its effects when administered intravenously although subjected to temperatures equal to or above body temperature.

45. Investigations into the variations undergone by *V. choleræ* on passage through flies.

R. B. LAL *and* S. C. GHOSAL, Calcutta.

Much controversy centres round the question of variability of *V. choleræ*. Some believe that atypical vibrios so commonly met with in the environment and other sources may undergo changes in some of their essential characteristics under certain conditions and may under another set of conditions revert to the original condition. Others hold that the vibrios have fixed characters and that the observed changes are explicable on other grounds. Experiments described here refer to certain changes observed in vibrios by passage through house flies, bred under aseptic condition with regard to gram-negative organisms and bacteriophage. Variations were observed in either direction with regard to metabolic characteristics and chemical constitution of vibrios. These were however not accompanied by other biochemical or serological changes. Significance of these observations from the epidemiological point of view is discussed.

46. Sero-positive reaction for syphilis in leprosy.

R. BANERJEA, Calcutta.

Kahn's test and Meinicke test of sera from 123 cases of lepers with no history and clinical manifestation of syphilis were simultaneously performed. 42·2 per cent. of these cases gave positive Kahn and 31·7 per cent. gave positive Meinicke reaction. The need for investigating the production of sero-positive reaction for syphilis in non-syphilitic lepers is stressed.

47. Studies on the extent of bacterial contamination of the atmosphere of big cities like Calcutta.

H. GHOSH *and* S. M. MUKHERJI, Calcutta.

Air collected from 29 different places of Calcutta was examined. Generally aerial Staphylococcus, Fungus, Lactic acid bacillus and Coccus, *B. subtilis*, *Chr. prodigiosus*, diphtheroids, etc. were found. The number of pathogenic micro-organisms was found to be very few. Attempt to culture Tubercle bacilli of the air was not successful due to overgrowth of fungi.

Average number of micro-organisms present per litre of air was found to be about 8,375. An individual living in the city of Calcutta inhales about 108,540,000 micro-organisms per day (in 24 hours).

Though most of the micro-organisms are non-pathogenic yet it was found that the autolyzed micro-organisms could produce irritation of the skin after intracutaneous injection.

The work is being continued to determine the seasonal variation of the number and flora of the micro-organisms of the atmosphere of the city of Calcutta and its suburbs.

48. Parasites of Anopheles mosquitoes in India.

M. O. T. IYENGAR, Calcutta.

Parasites of Anopheles in India are (1) mites, (2) culicoides, (3) coelomomyces, (4) microsporidia, and (5) mermis. The first-mentioned two parasites are ectoparasitic and do not cause any serious injury to the host. The others which are endoparasites cause fatal results in the infected host. The life-histories of these parasites and their importance in the natural control of Anopheles are discussed.

49. On a malarial infection in a paddy-bird.

B. C. BASU, Calcutta.

A plasmodium of the paddy-bird is described. The infection is easily transmitted from one paddy-bird to another by blood inoculation. Sparrows, crows, domestic fowls and canaries are not susceptible to this infection.

The course of the disease is considerably severe, the mortality being 66·6%. After an average incubation period of 7·42 days (varying from 2 to 20 days) the plasmodia appear in the blood, multiply rapidly, are present for 2 to 16 days (average 7·31 days) in the peripheral blood, and then disappear. Some (39·7%) birds died at the height of the infection; some (26·9%) after the plasmodia have disappeared from the peripheral blood and some (33·4%) recovered.

There was no relapse in any case. In majority of the birds which have recovered from the infection there is a solid immunity. Eight old wild birds were refractory to inoculation. A number of young ones were found infected in nature. During the height of infection the internal viscera swarm with the parasites and they disappear simultaneously with their disappearance from the peripheral blood.

Previous records of plasmodia of birds are discussed and it is suggested that the name *Plasmodium heroni* nov. sp. be given provisionally to this organism as the bird is commonly known as ' Pond heron '.

50. On the relation of hydrogen-ion concentration of waters to anopheline larval breeding.

S. SESHAGIRI RAO *and* C. ANANDARAMA RAO, Mysore.

It has been generally stated that ' Carrier ' anopheline mosquitoes breed in waters which have a *p*H range from 6·2 to 8·0 whereas certain species have been found to thrive even at very low *p*H readings ; but as a rule extremes of *p*H are inhibitory to anopheline larval growth. In this paper the relationship of *p*H values on the anopheline larval breeding has been studied. It has been found that breeding of the larvæ takes place freely in waters of *p*H range of from 7·4 to 8·0. There appears to exist a rather remote relationship between *p*H of waters and the larval intensity as found out by these experiments.

The rôle of other analytical factors on anopheline larval growth is under investigation.

51. A contribution to the pathology of cholera.

H. N. Chatterjee *and* S. K. Sen Gupta, Calcutta.

There is very little visible change in the intestinal tract to account for the symptoms of cholera. Changes are outlined in the structure of the bone-marrow, the adrenal, the thymus and the pituitary which indicate a kind of allergic or histamine shock. There is also a hyperplasia of the thyroid gland, the colloid material showing an acid reaction indicating a possible hypofunction. Enlargement of the thymus is a very noticeable feature possibly indicating a somewhat close connection or 'susceptibility' to this acute condition. The disfunction of the kidney seems to be associated with some kind of allergic shock and with the changes produced in the endocrines and in the serum electrolytes rather than to any gross structural change.

52. Modern views on the causation of tumours and some observations on the chemotherapy of tumours.

H. N. Mukherjee, Calcutta.

Modern views on the causation of tumours and various chemotherapeutic attempts on cancer along with the writer's own work with tissue oxidisers are summarized in this paper.

53. Studies on Van den Bergh's test.

Amulyaratan Chakravarti, Calcutta.

A critical study of the test was done by the writer and the results are stated in the different tables. A large number of clinical cases of jaundice was also studied and the reactions stated.

The writer has shown that bile salts play a very important rôle in the diazo-colour phenomenon. While Sneider and Reinhold's contention is quite correct that higher concentration of bilirubin would give an immediate direct reaction, it does not hold good for all the reactions. Addition of a little bile salts would bring about a prompt direct reaction in a concentration of bilirubin which otherwise would give negative results.

The presence of some amount of hæmoglobin along with bile salts and bilirubin is responsible for the biphasic type of reaction. Delayed direct reaction is very rarely obtained and is due to the presence of bilirubin only and of fairly low concentration. Addition of a little bile-salts or bile or even caffein-soda-salicylas would make the delayed direct to immediate direct reaction.

The writer concludes that (1) there is no ground to assume two types of bilirubin. (2) bile-salts play a great rôle in the development of azo-bilirubin, (3) the colour phenomenon depends as much on the concentration of bilirubin as on other factors leading to quick azotisation. The author considers that the different types of reactions can be explained by a more rational and practical way.

54. Pathogenesis and investigation on the pathological gall-bladder.

P. N. Ray, Calcutta.

Cholecystitis is perhaps the commonest cause of surgical dyspepsia in Bengal. The subject is usually a female, about 25 years of age. Females comprise 74 per cent. of the total. 62 per cent. were multiparous.

The infection is usually intramural, being probably blood-borne or carried through the lymphatics from the stomach, duodenum or appendix.

Blood cholesterol was found to vary between 75–175 mg. per 100 c.c. The highest figure was 266 mg. in jaundice. Bile cholesterol seldom exceeded 500 mg.

Of the associated infections appendicitis formed 39, alimentary diseases 46, and puerperal sepsis 31 per cent.

Culture of gall-bladder bile was negative in over 50 per cent. of cases. The organisms isolated were *Bact. coli, Bact. typhosus, Bact. aerogenes lactis* and *Micrococcus catarrhalis.* Culture of the submucous and subserous coats of the gall-bladder and the cystic gland yielded the following organisms, *Bact. coli, Bact. typhosus, B. welchii, Streptococcus viridans, Streptococcus hæmolyticus,* and *Bact. aerogenes lactis.* Samples of fæces were also cultured.

55. The bone-marrow studies of kala-azar.

C. C. Basu *and* H. N. Chatterjee, Calcutta.

Different stages of the affection of the bone-marrow by the Leishman-Donovan bodies are outlined.

The various characteristic changes in the blood such as the progressive leucopenia and neutropenia as well as the increasing anæmia found in cases of kala-azar are explained in the light of these findings.

56. Biological tests for the diagnosis of pregnancy.

F. A. E. Crew, Edinburgh.

Of the many biological inventions that are being employed in the service of mankind, that which is concerned with the recognition of pregnancy in its earliest stages is amongst the most sensational and useful. Its value is such as to make it desirable that it should be included in all programmes for the abolition of maternal morbidity. The routine tests now universally used are biological tests, but it is not improbable that these will give place later to chemical tests and it is to this end that much research is now being directed.

The Friedman, the Aschheim Zondek and the *Xenopus Lævis* tests have different qualities which can be used with advantage in the identification of different physiological and pathological conditions. These tests are best carried out in specially organized laboratories dealing with large numbers. Such laboratories provide unique facilities for research of great promise.

57. Erythrocytic studies in anæmia of pregnancy, as a guide to the blood pathology and therapy.

H. N. Chatterjee, Calcutta.

Cases of anæmia of pregnancy pass through different phases of blood picture. One and the same case may pass through normocytic, microcytic or macrocytic stage according to the severity of the condition. The prognosis and the therapeutic results of the different stages are discussed in the light of the observations made.

58. Hydatidiform mole—a statistical and clinicalt sudy.

P. C. Das, Calcutta.

The study was undertaken with the idea of ascertaining (1) frequency of occurrence, (2) the effects of (*a*) age, (*b*) parity upon its production, and (3) duration of pregnancy, in Indian subjects particularly Bengalees. The results are compared with similar results collected from European and American literature.

The frequency is worked out from a total of 203,180 pregnancies. In Europe the average frequency is 1 : 2140 whereas in India it is 1 : 361. The greatest number of cases occurred among Europeans in the 3rd decade followed by 4th, 5th and 2nd in order of frequency; among Indians greatest number of cases were also in the 3rd decade with nearly equal number of cases below 20 and above 31 years. The incidence of average age is 27·3 years (Indian) and 28·9 years (European). It occurs much more frequently in multiparæ, about 88% occurring among Indians. Regarding duration of pregnancy, the longest duration was 25 weeks and the shortest was 4 weeks, the largest number of cases occurring between 12 to 20 weeks. All the cases were treated with manual removal excepting 3 cases. The immediate mortality is 7%.

59. The study of the leucocyte counts in the anæmia of pregnancy in Indian women.

H. N. CHATTERJEE, Calcutta.

The hæmatology of anæmia of pregnancy presents an opportunity for studying the physiological correlation between the leucocyte-forming and erythrocyte-forming functions of the hæmopoietic organs. The study reveals that there is a sort of ' threshold ' between the proportions of the two varieties of cells. The effects of secondary complications, confinement, liver therapy and the blood group are discussed. The salient features of the Schilling differential count are put forth and their value in the treatment and prognosis also laid down.

60. The problems of carcinoma cervix-uteri in Bengal.

SUBODH MITRA, Calcutta.

In Seva Sadan Women's Hospital in Calcutta during last 10 years (1926–1936), about 8,552 patients were admitted into the gynæcological clinic, of which 921 were carcinoma cervix cases. i.e. roughly every 10th patient was a cancer uterus case.

Next, cases have been geographically mapped out showing that practically every district of Bengal contributes to the number of such cases. Patients have been treated mostly with radium and deep X-Rays and since last four years, operable cases have been treated with radical vaginal operation and post-operative radiation. Cases have been followed up year by year, up to 9 years. End results show 72·7% of 5-year cure in the 1st group, 41%—in 2nd group and 11·1% in the total number of cases. End results have been compared with those of England and the Continent. The end results can be greatly improved if cases are detected early, and adequate treatment given immediately.

61. The age order of epiphysial union in Bengalee girls.

S. K. BASU *and* SUDHIR BASU, Calcutta.

The paper is a study of the age at which epiphysial centres unite with the bodies of different bones. The determination of the exact age in the living is of great medico-legal importance. The present work is based on a roentgenographic investigation of the bones round the joints in 130 middle class Bengalee Hindu girls whose exact age was obtained with great accuracy. In selecting the subjects of this series the authors were careful to exclude all cases showing pathological conditions of growth and development. The results arrived at differ from those worked out by researchers in other parts of the world. These differences help to indicate the many factors, e.g. racial, climatic, dietetic, etc. that are responsible for the anomalies in the growth pattern amongst people of various countries.

62. A note on toxicology of linseed plant (*Linum usitatissimum*).

K. N. BAGCHI *and* H. D. GANGULI, Calcutta.

There were several fatal cases of accidental poisoning of cattle in a village in Bihar and hydrocyanic acid was detected in viscera and stomach-content of some of them. It was ascertained that the animals developed the symptoms of poisoning after grazing in a linseed field when the linseed flowers were fairly mature with the seeds just developed.

A cyanogenetic glucoside—Linamarin—is known to be present in linseed but it is not known if any other part of linseed plant contains this glucoside. The analysis of leaves, flowers, fruits, seeds and also of the oil-cake gives the following result :—

Leaves and stems	a trace of HCN.
Flowers (before fertilization)	0·08% ,,
Immature fruits or capsules	0·692% ,,
Mature fruits (when ready for harvesting) ..	0·08% ,,
Linseed	0·06% ,,
Oil-cake	0·032% ,,

It is found that the maximum amount of HCN is obtained by soaking the plant products for about 12 hours in water before distillation while the same treatment with an alkali gives the minimum value. With a dilute acid (0·4% HCl) the yield of HCN is slightly less than that with pure water. It is therefore evident that the enzyme Linase, producing the hydrolysis of this cyanogenetic compound acts best in a neutral medium and its action is retarded by an alkali. The risk of HCN-poisoning appears to depend on the reaction of the gastric juice, the reduced acidity or a neutral reaction helping to bring about a complete hydrolysis of the cyanogenetic compound and to produce the maximum amount of HCN. An alkaline reaction tends to prevent the hydrolysis. An alkali may therefore be regarded as an antidote against linseed-plant poisoning. The investigation is in progress.

63. Experiments on the stability of seminal stains from a medico-legal standpoint.

S. N. CHAKRAVARTI *and* S. N. ROY, Agra.

During the course of examination of thousands of articles for spermatozoa, it has been found that an unusually large proportion of negative results is obtained in cases of mixed blood and seminal stains and in very old stain cases. To throw light on the underlying causes of this, a series of experiments were instituted which show that while Florence test is given by dry seminal stains even after 100 days, in case of mixed stains Florence test is not given after 44 days, although complete spermatozoa can be detected. In case of wet stains, Florence test is not given even after 48 hours and tails begin to disappear after 10 days and are undetectable after 75 days. These results are highly important and show that too much importance should not be attached to Florence test even as a negative test. These experiments further show that it would be justifiable to declare a positive result if a number of good heads are found.

64. Viscosity of mustard oil and its common adulterants.

A. K. SEN, Calcutta.

There is a number of viscosimeters in use in different countries for the determination of viscosity of oils relative to a standard fluid. The oils tested are those used for lubrication and similar purposes. The Ostwald-Poiseuille apparatus does not appear to be favoured for these tests.

The difficulty of judging the genuineness ot mustard oil from a consideration of its chemical constants has proved a considerable handicap for analysts. The values of these constants are subject to wide variations as different varieties of mustard seeds are used in the manufacture of the oil.

Viscosity being highly characteristic of mustard oil the study of the value relative to distilled water was undertaken and the Ostwald-Poiseuille apparatus was considered to be suitable for this laboratory investigation. As the tubes supplied by the continental makers have a very narrow capillary, good locally made tubes having wider capillaries were tried and were found to give the same results as the imported tubes, provided the flow of water was not too quick and the time could be accurately determined.

The relative viscosity of mustard oil as determined in the Ostwald-Poiseuille apparatus was found to be fairly characteristic and of undoubted value where there were no special tests for the detection of adulterants.

65. Application of scientific method to epidemiological research.

R. B. Lal, Calcutta.

While many branches of the medical science have more or less fully developed definite techniques for the elucidation of their unsolved problems, considerable vagueness still surrounds the method of approach in the case of epidemiological research. This is partly due to the great variety and vastness of the problems concerned in epidemiological phenomena and partly to insufficient attention paid by the profession to co-ordinated laboratory and field work. The various mental processes and the general technical methods involved in epidemiological research are discussed and illustrated by their application in recent investigations on epidemic dropsy.

66. An epidemic of cholera in a rural area in South India caused by the ' Ogawa ' type of *V. choleræ.*

K. V. Venkatraman *and* C. G. Pandit, Guindy.

(Indian Research Fund Association.)

References to the literature on serological types of *V. choleræ* are given. The Southern districts of the Madras Presidency experienced a severe epidemic of cholera in 1936. The course of the epidemic in one health range and the results of examination of the vibrios isolated at different periods of the epidemic are recorded. In 39 villages with a population of 181,668 there were 2,839 attacks and 1,257 deaths from cholera in 1936. The attack-rate and death-rate have been the highest for several years. Out cf 481 deaths investigated, 426 occurred within 2 days after the onset of symptoms, the period in most cases being less than 24 hours.

Of 131 cases examined bacteriologically, *V. choleræ* were isolated from 97. 84 of these were submitted to a full examination. They were all of them typical cholera vibrios, gave positive cholera red reaction, were non-hæmolytic and fermented saccharose and mannose with acid only and did not ferment arabinose. By agglutination and absorption tests, they were shown to be of the ' Ogawa ' type. The conclusion drawn is that Ogawa type *V. choleræ* can cause a severe epidemic of cholera.

67. A tuberculin-survey in a hill area in the Darjeeling District.

A. C. UKIL *and* S. R. GUHA THAKURTA, Calcutta.

The present investigation was undertaken with a view to ascertain the degree of tuberculization of the people at Kalimpong and its neighbourhood.

A total of 1,650 persons were examined clinically and with Mantoux test, of which 1,152 were males and 498 were females. 91% of those were children. As regards race, 1,163 or the bulk of them were Nepalis, 185 were Lepchas, 135 were Bhutias, 33 were Chinese and others 134. 954 of them were of 'rural' and 694 of 'semi-rural' domicile. A history of previous contact with tuberculosis cases was available in only 7% of cases.

The incidence of total positives, was 44·5%. The incidence among children below 15 years was 38·6% and 55·3% among adults, males giving 40·7% and females 38·9% positives. Rural people showed an incidence of 34·9% and semi-rural 47·4%. Bustee areas showed less infection than the town proper and far-off bazar areas. The Chinese showed the highest incidence, viz., 54·6%. 42·1% of the total reactors gave intense reaction, those belonging to the adolescent age-group showing a comparatively higher incidence. The incidence among contacts was 75·6%, non-contacts showing 37·5% positives. Contacts showed more intense reactions than non-contacts.

A survey carried out by the author in the plains in Bengal, Behar, Assam and Madras showed the incidence of total positives to be almost the same as in a semi-rural area to-day.

68. Tuberculosis among home-contacts.

A. C. UKIL, Calcutta.

444 children below 15 years were examined. 343 were in contact with 'open', 27 with 'closed' and 74 with 'unknown sputum' cases. 409 had 'intimate' and 35 had 'distant' contact. Sources of contact were as follows: 'immediate' 313; 'recent' 109; 'remote' 22. Two-thirds belonged to poorer classes.

The percentage of positive reactors varied directly with age. The 'unknown sputum'—contact group showed the highest incidence of infection—85% as against 71% of the total.

Radiological examination revealed healed, arrested and active lesions in 59% of the cases. Thus in 12% of cases, radiological examination failed to detect evidences of infection.

The presence of active parenchymal lesions was detected in 15%—a very high rate. This incidence varied indirectly with age and, in relation to positive reactors, indicated that the younger the age the greater was the risk of disease. In contradistinction to this, it was found that the presence of quiescent lesions varied directly with age.

History elicited over a period of 5 years proved that tuberculosis mortality rate among children of these homes was double that of the general mortality, while in adults it was three and a half times higher.

69. Malaria problems in different topographical regions.

M. O. T. IYENGAR, Calcutta.

In the province of Bengal the different topographical regions show considerable variations in the anopheline fauna and in the factors that determine the prevalence of malaria. The conditions prevailing in these regions are discussed in relation to their bearing on malarial incidence and the problems connected with the control of malaria.

70. Increase of malaria in Manbhum, 1936.

K. Mitra, Patna.

A short-period Malaria investigation in Sadar subdivision of Manbhum district was carried out in March last. The district for long had enjoyed a reputation of salubrity. Old records show that fever death-rates started increasing from the beginning of twentieth century. Inward population movement started with the opening of the Jharia coalfields (1894). Out of a total population of 1,810,890 persons only 347 per mille are earners or bread-winners. Of the earners 63·1% follow 'ordinary cultivation' and 11·4% in coal industry. 92% of the agriculturists are either tenant cultivators or agricultural labourers. Spleen survey in eight villages were made. Anopheline mosquitoes were found to breed in 'Bundhs' and river-beds. *A. culicifacies, A. annularis, A. pallidus, A. vagus, A. fluviatilis* and *A. jeyporiensis* were found prevalent. Scrutiny of Malaria attendance at dispensaries reveal (1) a marked autumn wave starting about a month after the rains set in and a small spring wave in April; (2) greatly enhanced incidence of Malaria in 1936; (3) increased Malaria attendance in dispensaries situated in the neighbourhood of villages with high spleen rates. Interesting feature of the 1936 outbreak was that greatly enhanced incidence of Malaria had no effect on death-rates either due to fever or all causes.

71. Some observations on the epidemiology of plague.

S. S. Sokhey *and* G. D. Chitre, Bombay.

Using a standardized constant infective dose of plague the resistance to plague of rats from different parts of India has been studied. From this study the fact emerges that there exist in nature strains of rats (Rattus rattus) resistant to plague. During an epizootic and an epidemic of plague in a particular locality susceptible strains die out leaving behind resistant strains. This ends an epidemic. Light is thrown on the possible factors which permit a fresh epidemic to start in that area. The effect of atmospheric temperature on the incidence of plague in a given locality is discussed.

72. The action of vitamin C and other reducing substances on certain toxins.

B. Ghosh *and* B. C. Guha, Calcutta.

Guinea-pigs have been found to be resistant to one m.l.d. of tetanus toxin which was mixed *in vitro* with different amounts of ascorbic acid. The behaviour of other reducing substances like cysteine, glutathione and hydroquinone towards the toxin has been investigated. Similar experiments are in progress with diphtheria toxin.

73. Investigation of available carbohydrates in some Bengal food-stuffs.

K. P. Basu *and* Md. Abdul Quader, Dacca.

The glucose, fructose, sucrose and starch in eight varieties of pulses and one bazar sample of rice have been determined. Sucrose was estimated by the increase in reducing power after inversion. The glucose/fructose ratio was calculated by solving the simultaneous equations obtained from an iodometric determination and from the estimation of reducing power by Shaffer-Hartmann's reagent.

	Glucose.	Fructose.	Sucrose.	Starch.	Total available carbohydrate.	Titratable acidity. ml N/10 NaOH 100g. of substance.
						c.c.
Bengal grm. (cicer Arietinum) ..	·0735	·1115	·1720	35·890	35·785	14·685
Soya bean (Glycine Hispida) ..	·1155	·1790	2·016	18·775	21·040	23·496
Lentil (Lens esculenta) ..	·0800	·2120	1·761	50·000	52·955	17·678
Green gram (Phaseolus Mungo) ..	·3575	·5185	·9215	47·265	49·050	20·629
Field pea (Pisum sativum) ..	·5200	·8900	3·3560	43·015	47·815	46·990
Arhar (Cajanus Indicus) ..	·1350	·2740	·4095	49·840	50·560	35·244
Black gram (Phaseolus Mungo Varr Linn.) ..	·1275	·1790	·1505	41·150	41·625	26·443
Khesari (Lathyrus Sativa) ..	·0850	·1710	·5195	50·145	50·915	32·356
Rice (Oryza Sativa), (Bazar sample) ..	·1590	·2430	2·235	71·330	74·467	10·279

74. Acid-base balance in some pulses. (Potential acidity.)

K. P. Basu *and* H. N. De, Dacca.

The potential acidities of the pulses Green gram (Phaselous mungo), Field pea (Pisum sativa), lentil (Lens esculenta), Khesari (Lathyrus sativa), Soya bean (Glycine histida) and arhar (Cajanus indicus) have been determined by analyzing their ash constituents. The acidity per 100 gms. is found to be least in the case of green gram (1·77) c.c. N. acid and highest in the case of Bengal gram (4·32) c.c. N. acid. Other pulses possess the values in between these two extremes.

It is concluded, that green gram is superior to the other pulses as regards the acid-base balance of its ash constituents.

75. The effect of supplementing the South Indian diet with calcium and phosphorus.

R. K. Pal *and* N. Singh, Coonoor.

(Indian Research Fund Association.)

Typical poor South Indian diets, largely based on rice, are deficient in mineral salts and particularly in calcium. Four batches of 12 young rats, about 50–60 grammes in weight were given a poor South Indian diet consisting of raw milled rice, dhal arhar, black gram, brinjal, amaranth leaves, raw plantain, gingelly oil, coconut and mutton in proportion to adult human daily intake as the basal diet. The second group was given 1·775 grms. of calcium lactate a third, 0·8875 gramme of alkaline potassium phosphate and a fourth, both calcium lactate and alkaline potassium phosphate, as daily additions to the basal diet. The experiment lasted for 10 weeks, during which their rate of growth was noted. Batches of three animals (males) from each group were kept in metabolism cages for four weeks and intake and excretion of calcium and phosphorus was determined and retention calculated. The same was repeated for groups of three females in each group. At the end of ten weeks the animals were bled to death under anæsthesia, blood from the heart being taken for estimation of serum calcium and phosphorus. A pathological examination of the thyroids and parathyroids was made.

The conclusion is that addition of calcium lactate enhances the nutritive value of Indian diets based on rice. Its effect is slightly increased if alkaline phosphate is added at the same time. The addition of alkaline phosphate alone has no supplementary effect on growth.

76. Lesions of peripheral nervous system in vitamin A deficiency.

M. V. Radhakrishna Rao, Coonoor.

(Indian Research Fund Association.)

The peripheral nervous system was studied in rabbits, rats and hens fed on diets deficient in vitamin A and carotene. Clinically, evidences of nervous disorder were rarely observed. Histological examination, however, revealed varying degree of degeneration of the myelin sheaths of the spinal nerves. The significance of the experimental findings as regards peripheral neuritis in the human being is discussed.

77. Studies on leprosy and vitamin B_2 (G) deficiency.

N. K. Basu, Calcutta.

Diets of patients attacked with leprosy are always poor in protein and vitamin-B complex. It has been found that factor B_2 is more prominently absent than B_1. A number of early cases of leprosy was treated with vitamin B concentrate from yeast, and the patients with anæsthetic patches showed marked improvement. Afterwards, following the method of Row and his colleagues, nodular leprosy was produced in white mice. In these experimental animals, it was also found that addition of vitamin-B_2 had a retarding effect, while its absence in the diet had a favourable effect in the production of the disease. Similarly, animal-protein and fat containing Vitamins A and D were also found to bear some relation to the disease.

78. Anti-diabetic factor of vitamin B complex.

N. K. Basu, Calcutta.

Following the usual method, vitamin B concentrate was prepared from yeast. And from this concentrate, a precipitate could be fractionated, which on injection into the rabbits lowered the blood sugar.

Vitamin B concentrate, when administered to diabetic patients, could maintain the level of blood sugar constantly to normal. In these patients, proportion of carbohydrate in their diet could be increased with a parallel increase of vitamin B concentrate intake.

Nature of this precipitate obtained from vitamin B concentrate was compared with all the known factors of vitamin B complex. It seemed to be an entirely new factor in B complex.

This new factor seems to have a specific action on blood-sugar. Nature of its action is discussed in the main paper. In all probability, it not only helps in the metabolism of carbohydrate in the body, but it stimulates the pancreas to secrete insulin, and this is borne out by experiments on lower animals.

79. The 'availability' of iron in Indian food-stuffs.

S. Ranganathan, Coonoor.

(Indian Research Fund Association.)

Recent experiments have shown that all the iron existing in food-stuffs, as determined by gross chemical analysis, is not 'available' for hæmoglobin regeneration. Chemical methods, involving the use of $\alpha\alpha'$ bipyridine, have been evolved to assess the amount of such 'available' iron in biological material, the results obtained agreeing very closely with those obtained by the complicated and time-consuming biological tests. An attempt was made to determine the 'availability' of iron in food-stuffs in common use in India and over 100 of them have thus been examined. Wide variations exist in the 'availability' of iron in the different groups. The iron in cereals is 'available' to the extent of about 40 per cent. while that in pulses is 'available' to a much smaller extent, about 15 per cent. Ragi (*Eleusine coracana*) is an exception in the cereal group in that it has an 'availability' of only 10 per cent. The other food-stuffs do not display any group characteristics.

80. 'Available' iron of Indian food-stuffs.

H. Goswami *and* U. Basu, Calcutta.

Sherman, Elvehjem and Hart have shown that the hæmoglobin formation by any iron food is directly proportional to the amount of inorganic iron as determined by Hill's dipyridyl method. It would be of considerable importance for medical as well as public health workers to know not only the total quantity of iron present in any food but the food-stuff that would supply the largest amount of inorganic or rather 'available' iron.

Following Hill's method as modified by Elvehjem and others, the percentages of 'available' iron in rice, wheat, sago, grams, lentil, bitter gourd, mustard, bananas, pistachio nut and tamarind have been determined. Various other vegetables, spices, nuts and fruits are also being studied.

81. Phytin-phosphorus content of Indian food-stuffs.

A. R. Sundararajan, Coonoor.

(Indian Research Fund Association.)

Phytin-phosphorus (calcium magnesium salt of inositol hexa-phosphoric acid) has been shown to be poorly assimilated by human beings. The so-called 'anti-calcifying action' of cereals has been explained on the grounds that the poor assimilability of the phosphorus present makes the calcium-phosphorus ratio unsuitable for calcification. The methods of McCance and Widdowson, suitably modified, was employed to determine the phytin-phosphorus content of fifty common Indian food-stuffs. Total phosphorus was also estimated with a view to determining the percentage of phytin-phosphorus. In general, it is found that cereals contain large amounts of this form of phosphorus while most of the leafy vegetables contain none.

Further work is in progress to discover the effect of cooking on the phytin-phosphorus contents.

82. Observations on the basal metabolism of Indian boys of six to sixteen years of age in Calcutta.

H. Ellis C. Wilson *and* N. C. Roy, Calcutta.

The data obtained are compared with corresponding figures for European children and inferences drawn as to the significance of climate and diet on metabolism.

83. Studies in human metabolism. Retention of nitrogen, calcium and phosphorus and elimination of uric and oxalic acids at different levels of rice intake.

K. P. Basu *and* M. N. Basak, Dacca.

(Indain Research Fund Association.)

A healthy young man of 18 (weight—48·92 kg.) served as the experimental subject. The following diets at three step levels of rice intake were taken:—

	Diet I.	Diet II.	Diet III.
Rice	200 g.	400 g.	600 g.
Sago	400 ,,	200 ,,	*Nil.*
Dal (Green gram)	25 ,,	25 ,,	25 ,,
Fat	25 ,,	25 ,,	25 ,,
Vegetables	200 ,,	200 ,,	200 ,,
Sugar	100 ,,	100 ,,	100 ,,

5 g. of common salt and the same amount of spices were taken each day.

These diets furnished about 3,000 calories per day.

The following table summarizes the results obtained:—

Diet.	Nitrogen balance in g.	Calcium balance in mg.	Phosphorus balance in mg.	Volume of urine in cc.	Fæcal weight in g.
I ..	−0·489	217	443	2,146	37·58
II ..	+1·368	139	399	2,080	36·03
III ..	+2·099	56	129	1,703	48·48

The nitrogen intake in Diet I, II and III was 3·765 g., 6·275 g. and 8·785 g. respectively.

The calcium intake in Diet I, II and III was 422 mg., 392 mg., and 362 mg. respectively.

The phosphorus intake in Diet I, II and III was 1,375 mg., 993 mg. and 611 mg. respectively.

84. The Bengalee schoolboy, his physical development, health and nutrition.

A. Chatterji, Calcutta.

The findings are based on the records of 33,151 students.

The value of the biometric average for assessing normality is questioned. The biometric averages are compared with averages obtained from normal students for the same age groups.

The rate of growth of the Bengalee student is considered and the following conclusions drawn:—

(*a*) Total gain in height during this period is 17·16 inches; in weight 71·48 lbs.; in chest girth 9·68 inches and in vital-capacity 2 litres. (*b*) The maximum rate of growth occurs during the period 11–16, and is particularly marked during the ages 12, 13 and 14. (*c*) There is a sudden fall in the rate of growth after the 16th year. (*d*) Height and chest-measurements are less variable than weight and vital-capacity as criteria of growth and development.

The value of the different methods for assessing normality is discussed.

The value of Ponderal Index, $\frac{\sqrt[3]{\text{Weight in kilo} \times 100}}{\text{Height in cms.}}$, as a nutritional index considered, its disadvantages are pointed out and a table for weight-height, chest-measurements on a time increment scale worked out to serve as a clinical ready reckoner. A table of annual increments for height, weight, chest-measurements and vital-capacity is given.

The findings of medical inspection are tabulated, the incidence of defective vision, malnutrition, enlarged tonsils, dental caries, enlarged liver and spleen, disease of the heart and lungs and pulmonary tuberculosis are considered.

A survey of the dietetic habits of the Bengalee students is made.

85. Pancreatic hormone and its functions.

CHARUBRATA RAY, Calcutta.

Sugar is of prime necessity to the body. When the supply of carbohydrates is adequately maintained pancreatic hormone helps to store up the sugar in the form of glycogen, and it not only inhibits the formation of sugar from other food-stuffs, e.g. proteins and fats but also helps them to carry on their essential rôle of repair and growth. In absence of sugar the check being removed the proteins and fats form sugar to meet the more urgent demand for fuel.

In diabetes—the power of oxidizing sugar is not lost. Deficiency of insulin allows the amino-acids to form sugar in the cells. The absorbed sugar after food does not get accommodation in the cells—thore is hyperglycemia and glycosuria. The body does not suffer from want of sugar but from protein inanition. Insulin alleviates the symptoms not by oxidizing sugar. It checks the proteins from breaking down to sugar, so the cells in absence of the sugar accommodates the sugar from the blood. The hyperglycemia and glycosuria disappear and the sugar undergoes normal combustion.

86. Glimpses into the practice and principles of medicine in India in the 7th century A.D.

D. V. S. REDDY, Vizagapatam.

It-Ching (635–713 A.D.) during his ten-year stay at Nalanda made a successful study of the science of Medicine. Translated a medical work ' Bhaishajya Vasthu '.

The contents of the book are valuable for medical history. *The philosophical background of the age*: Recognition of the value of health—theory of Karma—belief in ' repetitions ', etc. But medicines and physicians requisitioned as the best and quickest means of getting relief. *Preventive outlook on medicine emphasized*: Elaborate rules of hygiene—(1) Exercises for health, (2) Baths, ordinary and medicinal, (3) Filtering, storing and distribution of water, (4) Foodstuffs, their effects in the body, diets peculiar to different parts of India, cleanliness in the preparation and serving of food, (5) Oral hygiene, tooth sticks and their therapeutic uses, (6) Nasal hygiene. Under *Curative Medicine*, the following topics are discussed: (1) Symptoms of bodily illness, (2) Methods of diagnosis, (3) Theories of causation of diseases, (4) Materia Medica, (5) Therapeutics, general, dietetic and medicinal, (6) Famous and popular prescriptions, (7) Hurtful treatments to be avoided. Interesting sidelights thrown on the social and religious practices connected with ill-health and disease. *Medical Economics*. *Training of the Physician*: Courses of study and text-books. Social status of the physician. The powers and limitations of the physician.

87. A plea for the promotion of the study of history of medicine in India.

D. V. S. Reddy, Vizagapatam.

History of medicine.—' A watch tower from which medicine could be studied as a whole in its developments, tendencies and in all its social implications.' Revival of interest due to ' the efforts of Littre, Daremberg and Sudhoff.

The problem of historiography.—The problem in other lands and Universities. Encouragement given to these studies. National and regional Medical Societies, Medical History Clubs, etc. Foundation of Institutes for the History of Medicine, Museums, and organization of exhibitions of ancient (and medieval) medical instruments, books or drawings.

Neglect of kindred studies in India.—The Universities should institute courses of lectures. Co-operation between the literary men (the Anthropologist, the Archæologist and Philosopher) and the medical man is necessary for editing texts. Documents and inscriptions throwing light on the epidemics of the ancient and middle ages, or the medical history of great personages or the medical institutions of the period, should be brought to our knowledge. The determination of the dates of the medical writers or of commentators fixing the age of the books, and copying of old breaking-down palmleaf manuscripts are urgently needed. Palæopathological researches on human remains discovered, examination and interpretation of medical antiquities, critical studies on the various classics of different periods should be commenced without delay.

88. Adamantinoma, reporting four jaw cases.

L. S. Ghosh, New Delhi.

These are common tumours of the jaws of long duration associated with the expansion and destruction of the affected bone and often with a history of dental crises and infection. Rarely, the growths which are of dental origin are met with in other situations.

The essential character of an adamantinoma is the presence of cylindrical and stellate epithelium, such as is seen in the enamel organ of the fœtus at the fifth month, in a highly vascular connective tissue stroma. Tissue resembling formed dental elements have been reported in adamantinoma and in one case of those reported here a cementum-like substance is present.

These tumours may occur at any age and in either sex and more commonly in the lower than in the upper jaw. Of the cases reported here, two occurred in male and two in female patients, the ages of the patients being forty-five, twenty-five, twenty-six and thirty, and the duration of the growth, one year, two years, about six months and six months respectively. Only one was an upper jaw tumour.

Adamantinoma frequently recurs after scraping: entire removal of the growth is essential, often necessitating resection of the jaw. Malignant changes of either the carcinomatous or sarcomatous type is a rare and late development, usually associated with a long history of inadequate operative interference.

89. Leucoderma—its ætiology and treatment.

G. Panja, Calcutta.

A discussion regarding the probable cause of the condition given. Treatment with various drugs and their effects described.

* * *

SECTION OF VETERINARY RESEARCH

President:—COL. SIR ARTHUR OLVER, KT., C.B., C.M.G., F.R.C.V.S., F.N.I.

Parasitology

1. Schistosomes and Schistosomiasis in India.

G. D. BHALERAO, Muktesar.

A short resumé of the work done so far on the Schistosomes and Schistosomiasis in India has been given. References have been made to the work in connexion with domestic ruminants and equines and an account is given of the important conditions in these animals such as nasal schistosomiasis, 'Gillar' or 'Phet' of ovines, nodular portal cirrhosis in enlarged liver of horses, and 'Kumri'. Mention is also made of the description of such species as *Schistosoma indicum, S. spindalis, Ornithobilharzia bomfordi,* and the nasal schistosome. Work done on the life-history and artificial infection with the nasal schistosome and *S. spindalis* has been stated. The work on the infection of pigs with *S. japonicum* and *S. incognitum* and of dogs with the latter species has been quoted. All the work recorded on the endemic and important human schistosomiasis has been summarized and mention has been made of the speculations regarding human schistosomiasis in India. Mention has also been made of the work done on artificial infection of monkeys and guinea-pigs with *S. spindalis.* References have been cited also to the cercarial fauna of this country, to the use of anthelmintics, and to the metazoan immunity, particularly in connexion with *S. spindalis.*

2. Observations on *Bartonellosis* in dogs.

H. N. RAY *and* J. A. IDNANI, Muktesar.

Pyrexia associated with progressive anæmia due to *Bartonella canis* Kikuth infection in dogs has been noted by the authors, and it is suggested that one of the different types of obscure canine fevers in India may be due to this intracorpuscular parasite. Kikuth (1927) and others state that *Bartonella* usually appear in the blood of splenectomized dogs, but in the experience of the present authors this infection was found to be inoculable into healthy unsplenectomized dogs producing acute symptoms and ultimate death of the host in several cases. Symptoms produced by this organism in experimental animals were similar to those observed in canine piroplasmosis, namely, high temperature (up to 105°F), icterus, mucopurulent discharge from the eyes, and progressive anæmia. On autopsy certain gross lesions of the spleen associated with a marked enlargement have been regularly seen, and these are considered at present to be characteristic of *Bartonellosis.*

3. The occurrence of air-sac mite, *Cytoleichus nudus* (Vizioli 1870), in fowls in India.

R. L. KAURA *and* S. GANAPATHY IYER, Muktesar.

The occurrence of mites within the air sacs of fowls is recorded for the first time in India. Although primarily parasitic in these sites, an extensive infestation of the organs had developed.

This mite is indistinguishable from *Cytoleichus nudus* (Vizioli 1870), popularly known as the air-sac mite.

On account of the difficulty in treating the affected fowls, it is considered to be a serious condition.

4. A form of verminous ophthalmia in equines.

P. R. Krishna Iyer, Muktesar.

Under the name of ' Periodic Ophthalmia ', a disease affecting the eyes of horses in the stud farms at Montgomery and Probynabad in the Punjab has been known for some years. The disease is of a recurrent nature and terminates in the affected animals going blind. The disease occurs at all times of the year, and no seasonal incidence has been observed. Mechanical irritation by flies and dust, bacteria and dietetic deficiency were suspected to be concerned in the causation, but these agents have been eliminated. Histopathological examination has revealed the disease to be of verminous origin, microfilaria being constantly present in sections of the affected eyes, and lachrymal glands. Intense eosinophilia, neutrophile and lymphocytic infiltration and fibroblastic activity are some of the other features seen. The transmitting agent appears to be a biting fly. From the morphological features and unsheathed character, the microfilaria appear to belong to some onchocercoid worm, but attempts at specific determination have so far failed. Experience gained so far tends to show that treatment with antimosan and other antimony preparations have an inhibitory effect on the progress of the condition.

5. Cutaneous microfilariasis in Indian cattle.

H. D. Srivastava, Muktesar.

A peculiar chronic form of skin disease in cattle was encountered at certain places in the Bombay Presidency. Subsequently, a six-year old bullock suffering from the disease was received. When the animal arrived at this Institute it had practically no hair on the greater part of its body, the skin showed numerous scars of healed lesions generalized over the body and from several places pieces of skin had peeled. The skin was very tender and peeled in patches at the slightest injury or abrasion, leaving bright red, bleeding surfaces. Nevertheless, the animal was in good bodily condition and fed well.

Though sections of pieces of skin from the animal revealed the presence of numerous microfilariæ, repeated examination of blood smears and the centrifuged deposits from large quantities of blood proved to be negative for larvæ. However, large numbers of larvæ were recovered from fresh pieces of skin incubated overnight in normal saline at body temperature. The microfilariæ, which are unsheathed, measure 0·252–0·28 mm. in length and 0·004 mm. in breadth. They have a rounded anterior end and a sharply pointed, curved posterior extremity. With the approach of winter the number of microfilariæ in the skin rapidly decreases and finally the larvæ practically disappear from the skin, which appears almost healed, but with the return of the hot season the larvæ and associated clinical manifestations reappear.

There is only one reference in literature to a somewhat similar disease occurring in Japanese cattle described as ' Wahi ', ' Kose ' or an elephantiasis-like disease by Oguni in 1927. The points of similarity between the Japanese and Indian disease are the seasonal incidence—both flaring up in summer—peeling of pieces of skin at the slightest injury, casting of the coat in patches, and the causative agents of both being unsheathed microfilariæ. The Indian disease differs from the Japanese in the absence of any predisposed sites, nodules in the skin, thickening of the skin at the neck and throat with subsequent development of elephantiasis, and the absence of the microfilariæ in the blood. The disease has been distinguished from the one caused by *Parafilaria multipapillosa*, and the causative agents have been described.

6. Stomach worms in the Indian domestic ducks.

H. D. SRIVASTAVA, Muktesar.

Last year the author reported for the first time the occurrence of members of two spirurid worms—*Acuaria* and *Tetrameres*—in the gizzard and proventriculus respectively of fowls in India. Materials were received from about half a dozen ducks for examination. In every case the proventriculus and gizzard showed the presence of several nodules of varying sizes. On opening the nodules they were found to contain surprisingly large numbers of specimens of a representative of the genus *Echinuria*, besides a little caseous matter. Each nodule has a small opening through which the eggs are discharged into the lumen of the proventriculus and gizzard and are finally passed out with the fæces. The eggs are swallowed by the intermediate host, which according to Hamann, is a water flea (*Daphnia pulex*). The final host acquires infestation by ingesting water fleas containing infective larvæ. The worms penetrate into the wall of the proventriculus and gizzard causing marked inflammation and the formation of nodules which may become large enough to cause mechanical interferences and even obstruction to the passage of food. The birds lose condition, become dull, feathers are ruffled and feeding may become suspended. Sudden death is known to occur. The infestation is serious as no treatment is at present known and prophylaxis is obviously impossible. The paper contains a description of the parasite.

The proventriculus of one of the ducks showed the presence of numerous specimens of *Tetrameres*.

7. Occurrence of whipworms and bloodflukes in Indian dogs.

H. D. SRIVASTAVA, Muktesar.

The paper records for the first time the occurrence of whipworms—*Trichuris vulpis*—in dogs in India. The infestation has been observed in about half a dozen cases. The parasite may be responsible for acute or chronic inflammation in the cæcum, rise in temperature and general signs of illness. Remarks on the life-history, pathogenicity and treatments are given.

The occurrence of schistosomiasis due to *Schistosoma suis* in dogs in Northern India is also reported.

8. Some unrecorded helminths from Indian ducks and geese.

H. D. SRIVASTAVA, Muktesar.

The occurrence of flukes in Indian domestic ducks and geese has not been recorded up to the present time. The author recovered from ducks received from Peshawar specimens of a monostome, an echinostome and a cestode. The monostome is referable to the genus *Catatropis* and resembles closely *Catatropis indicus* Srivastava, 1934, parasitic in the Indian domestic fowl. The paper contains an account of the three unrecorded parasites.

The occurrence of *Echinostoma revolutum* in Indian geese is also recorded.

9. Four new trematodes of the family *Monorchidæ* Odhner, 1911, from Indian marine food-fishes.

H. D. SRIVASTAVA, Muktesar.

Up to the present time only one representative—*Asymphylodora indica*—of this family in Indian hosts has been described by the author in 1935. In the present paper the author describes a new species of the genus *Proctotrema* Odhner, 1911, and three species referable to two new genera. In one of the two new genera the eggs have a polar filament—a unique feature for the family Monorchidæ. The systematic positions of the new parasites have been determined.

10. Four new trematodes of the family *Acanthocolpidæ* Luhe, 1909, from Indian marine food-fishes.

H. D. SRIVASTAVA, Muktesar.

Luhe in 1906 created the genus *Acanthocolpus* for *A. liodorus*, parasitic in the intestine of a fish obtained from Ceylon. Hitherto the genus is represented only by the type species. The paper contains an account of four new species of the genus. The relationships of the four new parasites are discussed. The diagnosis of the genus has been revised, and a key to its species is given.

11. Studies on the trematodes of the family *Allocreadiidæ*, parasitic in Indian marine food-fishes.

H. D. SRIVASTAVA, Muktesar.

In this paper nine new trematodes referable as follows, one to the genus *Lepocreoidioides* Yamaguti, 1936, three to *Lebouria* Nicoll, 1909, three to *Opechona* Looss, 1907, one to *Allocreadium* Looss, 1900, and one to a new genus are described. In its systematic relationship the new genus stands between the true Allocreadid trematodes and members of the Opecaelinæ. It resembles the latter sub-family in the character of the male genital ducts. The relationships of the new parasites have been discussed in detail.

12. Two new genera of digenetic trematodes from Indian hosts.

H. D. SRIVASTAVA, Muktesar.

Two new trematodes referable to the families *Zoogonidæ* and *Acanthostomidæ* are described. They were found in the gut of Indian marine food-fishes. The representative of the former family is characterized by the topography of the gonads, extent of intestinal cæca and cirrus sac and the peculiar shape and position of the vitellaria. The peculiarities of the form assigned to the family *Acanthostomidæ* are the presence of a peculiar bell-shaped vestibule in front of the oral sucker, presence of two ani, and the character of the ovary. The relationship of the two genera with the allied forms has been discussed.

13. Verminous pneumonia in Indian buffaloes.

H. D. SRIVASTAVA, Muktesar.

Verminous pneumonia in domestic animals is one of the most serious and outstanding of parasitic diseases for which no satisfactory method of treatment or prevention is known. Apart from the larvæ of certain roundworms which pass through the lungs during their course of migration in the body, there are several worms which have their final habitat in the lungs. Amongst the ruminants representatives of four genera of lungworms—*Dictyocaulus*, *Protostrongylus*, *Muellerius* and *Varestrongylus* are found. *D. viviparus* occurs in the bronchii of cattle while *D. filaria*, *P. rufescens*, *M. capillaris* and *V. pneumonicus* occur in the lungs of sheep and goats. Representatives of the genus *Protostrongylus* are so far known to occur in the lungs of goats and sheep only. A piece of a lung from a buffalo was received which on examination revealed the presence of several specimens of an interesting representative of the genus *Protostrongylus*. The worms were associated with pneumonia in the piece of lung. In literature the occurrence of lungworms in buffaloes has not hitherto been recorded. A description of the species of *Protostrongylus* responsible for causing pneumonia in Indian buffaloes is given.

Protozoology

14. Surra in Hyderabad State.

M. R. MAHAJAN, Hyderabad.

In this paper are recorded observations made in the State since 1932. Surra in solipeds is being treated with a single injection of Naganol given intravenously in a ten per cent. solution. A success of 75 per cent. is recorded, 25 per cent. having relapsed due probably to Naganol failing to sterilize the cerebrospinal fluid in cases that were in the advanced stage of the disease.

Surra in the bovine is recorded in acute form especially in bullocks when they are worked hard during the early winter months. Field experimental work undertaken to study the *Trypanosoma* concerned gave indications of this being only *Trypanosoma evansi*, the view being supported by the Imperial Veterinary Research Institute, Muktesar. In the treatment of bovine Surra, Naganol in a ten per cent. solution given intravenously is advised in early stage, but in the acute and fatal stage Tartar emetic is recommended.

In regard to the vector problem the author records the findings of viable trypanosomes, and *Crithidia tabani* in the fly *Tabanus rabidus*.

Trypanosoma theileri was recovered for the first time in Hyderabad, its identity being confirmed by the Imperial Veterinary Research Institute, Muktesar.

Mention is also made of the occurrence of Surra in the camel.

15. Rhinosporidiosis in bovines in the MadrasP residency, with a discussion on the probable modes of infection.

M. ANANTNARAYAN RAO, Madras.

The author notes that the number of cases of rhinosporidiosis in animals, reported from various parts of the world, is small and those reports refer to three equines in South Africa and one in Uruguay. A few years ago the disease affecting two bullocks, one cow and one pony was recorded in the Madras Presidency. Since then the disease has been diagnosed in eighteen bullocks and one pony in the same province. It would seem that rhinosporidiosis in bovines has been reported so far only from the Madras Presidency and from no other part of the world.

It is observed that in animals, just as it is in a large majority of human beings, the lesions are found in the nose, and the presence of a trauma in the nose appears to be necessary for the development of the lesions. In the Madras Presidency, the disease is found affecting both men and animals in certain districts. Rhinosporidium has not been reported from animals from North India, though it has been reported to affect the human beings in certain provinces.

The author has discussed in his paper the resemblance in the histopathology, etc. of the lesions in man and animals and suggests that the causal organisms may be identical in them. While describing the contents of the asci of rhinosporidium, the author suggests that the large spores may be analogous to seeds of plants and are meant to complete their biological destiny outside the animal body. He suggests that those spores may germinate in manure into a saprophytic fungus whose end products are infective to healthy animals, since direct transmission with the large spores from the lesions is not possible. It is also suggested that the small-sized spores, which were hitherto considered as undeveloped ones, are really not so, but they are meant to continue the parasitic phase in the tissue of the host.

Some amount of success is claimed in cultivating the fungus in sterile cowdung and the author suggests that the infection to man and animals may be through dust raised while ploughing fields manured with bovine dung, since a large number of cases of rhinosporidiosis are met with in men and animals engaged in agriculture. The probability of the infection being water-borne is also discussed. The paper is illustrated with some photomicrographs of lesions, etc. from bovines and equines.

16. Rhinosporidiosis in equines. Record of another case in India.

LAKSHMI SAHAI, Patna.

In this paper the author records the discovery of another case of rhinosporidiosis in equines in India in a country-bred mare at Bargarh in the Sambalpur district of Orissa, the first case having been recorded by Krishnamurti Ayyar in Madras in 1932.

The animal, which had a noisy breathing and blood-stained mucous discharge oozing from one of the nostrils, on examination showed a small cauliflower-like growth about 1 inch long and ½ inch thick situated in the anterior part of the nasal chamber slightly obstructing the passage.

On histological examination the growth revealed all the essential features of rhinosporidiosis recorded by Krishnamurti Ayyar in the case from Madras.

Underlying the covering stratified squamous epithelium in the superficial layers of the highly vascular subjacent connective tissue were present numerous cysts or sporangia in various stages of development, the fully mature ones being seen to increase in size, approach the surface and burst to discharge the spores.

It is suggested that further systematic search may perhaps reveal the presence of many more cases in other parts of India, a subject of some importance in view of the close connection between and possible identity of *Rhinosporidium equi* and *Rhinosporidium seeberi*, the causal parasite of Rhinosporidiosis in man.

17. Experiments on the transmission of Surra (*Trypanosoma evansi* infection) through the agency of *Ornithodorus papillipes* Birula, with remarks upon the bionomics of this tick.

S. K. SEN, Muktesar.

Cross and his collaborators (1921-22), in the Punjab, recorded having successfully reproduced surra in laboratory animals through the agency of the tick *Ornithodorus papillipes* and also postulated the occurrence of a cyclical development of the surra parasite within the tissues of this tick. The present experiments were undertaken to obtain confirmation of their findings, a supply of ticks for this work having been received through the courtesy of the Principal of the Punjab Veterinary College. A total of 502 ticks were fed on guinea-pigs showing surra trypanosomes at the rate of 12 to 40 per field in their circulating blood and the infectivity of these ticks was later tested, in batches of 5 to 35, on healthy rabbits, at intervals ranging from 2 to 50 days, but none of the rabbits developed the infection during an observation period extending over about 25 days. These results would appear to be in accord with those recorded, at Liverpool, by Yorke and Macfie (1924), who, however, regard it as possible that their failure to reproduce the disease in this manner is attributable to the fact that, immediately after their infective feed, the ticks were subjected to relatively low temperatures during their journey from India to England in the month of December. A proportion of the ticks used in these experiments were therefore kept in an incubator maintained at 25°C., but they proved to be no more infective than those kept at room temperature (20°C.).

The paper includes some observations on the bionomics of the young forms of *O. papillipes.*

18. On the nuclear structure of *Babesia bigemina* (Smith and Kilbourne).

H. N. Ray, Muktesar.

In 1930 Dennis from America described the structure of the nucleus of *Babesia bigemina* and since he noted the presence of blepharoplast in this organism he suggested its affinity with the Flagellata. According to him *Babesia* is of flagellate origin, and even if spirozoan, indicative of the polyphletic origin of that group.

In this article the author has described the result of his studies on the distribution of chromatin in the nucleus of the Indian strain of *B. bigemina.* The nuclear chromatin, as revealed by Feulgen's reaction, was found chiefly to be confined to the apical portion of the parasite, while a circular row of fine chromatin beads appeared to be connected with that main mass of chromatin. The nuclear structure presented varied appearances with different fixatives and stains. No evidence of a blepharoplast was however forthcoming.

19. Observations on the forms of *Babesia gibsoni* (Patton) in dogs.

H. N. Ray *and* J. A. Idnani, Muktesar.

In view of our scanty knowledge about the morphology and significance of various forms of *B. gibsoni* in the verterbrate host, a detailed study was made, and the findings are recorded in this article.

Usually two types of the parasite, viz. ring forms and thin elongated forms, are met with in the smears made from the peripheral blood and in internal organs such as spleen, liver, and bone marrow. The ring forms were found to multiply by repeated binary fission until 12–16 merozoites were formed; while the thin elongated forms were observed to multiply in a manner which suggested a process of schizogony and gave rise to more than 30 merozoites in a corpuscle. Sometimes corpuscles infected with both the forms were seen in smears from the peripheral blood. This morphological differentiation into two forms is highly suggestive of sexual dimorphism in *B. gibsoni.*

20. On the occurrence of *Babesia bovis* Starcovici, 1893.

J. A. Idnani, Muktesar.

Hæmoglobinuric fever in an Indian buffalo ascribable to what appears to be *Babesia bovis* Starcovici (1893) infection for the first time in this country is recorded. Blood smears from this animal were forwarded to this Institute from one of the Military Dairy farms with the history of acute piroplasmosis associated with hæmoglobinuria. Trypan blue had been administered without producing any effect.

On examination of the smears, the parasites were observed to be much smaller than those of tropical red-water, viz. *Babesia bigemina*; the angle at which the pointed ends of the double pears met was widely divergent and in some cases falling in a straight line. The characteristic marginal position of the parasites in the infected cells was also noticed.

The morphology of this organism as compared with that of *Babesia bovis* described by Wenyon (1926) presented no difference.

21. Bovine Theileriasis—preliminary report.

S. C. A. DATTA, Muktesar.

Since the beginning of this century, *Theileria* parasites have been seen in the blood of Indian cattle and known as the 'small piroplasms' of Robert Koch, but researches upon this group of organisms may be said to date from 1925 and some advances have already been recorded. The morbid anatomy and histopathology of Theileriasis have not yet been studied in any great detail. The result of the studies so far carried out is described in this paper. The author has found that the predilection seat for the multiplication of the parasite is provided by the lymphoid tissue generally, including that in glands, spleen and other organs. Hæmorrhages resulting from parasitized endothelium of vessels have been seen in most organs. Large amount of cellular infiltrations in the Glisson's capsule of the liver and engorgement of capillaries with lymphocytes in particular have been constantly seen. Schizonts are more abundant in this organ than elsewhere. In addition to extravasated blood and blood pigments, the spleen shows enlargement of the malpighian bodies and the presence of parasites. In the kidneys, perivascular cellular infiltration, increase of the interstitium, and the very characteristic picture of minute superficial elevations with hæmorrhagic centres have been noteworthy. Parasites have been detected in almost all internal organs, including the brain. The morbid material under study has consisted of tissues collected from natural and experimental cases of acute Theileriasis.

Of the many therapeutic agents tried so far in the treatment of acute experimental cases, antisera from recovered cases have been found to give promising results. The second part of the article deals with the results obtained.

Nutrition

22. Carotinoid feeding and goat's milk.

B. N. BANERJEE *and* N. C. DATTA, Bangalore.

The possibilities of feeding goats with tender leaves, carrots, and grasses have been studied. The physiology of the goat is different from the cow or buffalo, in that it either converts carotin into Vitamin A or rejects it. No carotin or xanthophyll can be detected in blood or milk fat even with excessive feeding. The nature of the carotin can be judged from the carotin content of the feed and fæces, and Vitamin A of the milk fat. Grasses are rich in beta carotin and leaves contain a high percentage of alpha and gamma carotin. The Vitamin A content of the milk fat can be increased with proper carotinoid feeding. The flow of milk as also the quality improves with carotinoid feeding.

23. The problem of Vitamin-A deficiency in the diet of farm animals.

K. C. SEN *and* P. A. SESHAN, Izatnagar.

This paper attempts to summarize the present position of avitaminosis-A so far as it relates to the practical feeding of farm animals.

Cereals, grainfeeds, vegetable oils and oil-cakes are found to be poor sources of carotene (the precursor of Vitamin-A) which is generally associated with the pigments of all plant material.

Green young forage plants are, however, found to be satisfactory sources of carotene for animals.

The Vitamin-A requirements of rats, dogs, poultry, swine and cattle are discussed. The excretion, storage and depletion of the Vitamin-A reserve of animals through reproduction and milk are described.

The point is stressed that the provision of suitable green feeds or pasture land is the only practical method of supplying the carotene requirement of farm animals. In this connection, the importance of preserving the Vitamin-A potency of green plants when converted into hay or silage has also been emphasized.

The probability of the existence of avitaminosis-A, a mild form under the ordinary conditions of stock feeding in India, and the need of rectifying this condition are also considered.

24. Preliminary note on the behaviour of rice *kura* (bran) as a cattle food.

M. CARBERY *and* INDUBHUSAN CHATTERJEE, Tejgaon (Deccan).

The bran and rice polish form a large supply (probably about 32 million maunds) of cheap and easily available cattle food. The bran is very rich in oil, P_2O_5, and also MgO but very poor in lime. Preliminary experiments conducted with rice straw at Dacca Animal Nutrition Section show that the results were poor. The cause of it is suggested to be associated with maladjustment of minerals, existence of phosphorous as phytin and possible presence of decalcifying factors.

25. The value of *Aus* paddy straw as a fodder.

INDUBHUSAN CHATTERJEE *and* MD. ABDUL HYE,
Tejgaon (Deccan).

The experiments conducted at the Animal Nutrition Section in Bengal show that *Aus* or Autumn rice straw is a much better roughage than *Aman* or Winter rice straw with respect to protein, lime and phosphorus. Data have been presented showing the behaviour in live weight, consumption, total digestible nutrients, etc. all pointing in favour of *Aus* straw.

26. Can Water Hyacinth be used as a cattle food ?

INDUBHUSAN CHATTERJEE *and* MD. ABDUL HYE,
Tejgaon (Deccan).

As on account of fodder scarcity hyacinth is used as cattle feed in some parts of Bengal, its investigation was started to test its effect when given (1) with rice straw and (2) with rice straw and cake. It is noticed that in the former case the results were poor but better results were obtained with cake. The hyacinth is very rich in potassium and chlorine and also lime. The palatability appears to vary with locality, season and more or less with individual likes and dislikes. Under the fodder scarcity of the province its partial use is unavoidable but it is better to feed it in controlled amount and always supplemented with cake.

27. The lime and phosphorus requirements of Bengal cattle.

INDUBHUSAN CHATTERJEE *and* S. K. TALAPATRA,
(Tejgaon Deccan).

Data from 24 individual tests have been presented suggesting the requirement of lime and phosphorus to be 48 grams CaO and 20 grams P_2O_5 per 1,000 lbs. live weight under the condition of rice straw feeding. The lime assimilation from rice straw is low and the requirement appears to be higher than under many other feeds. The phosphate deficiency is very large.

Pathology and Bacteriology

28. An outbreak of Equine Encephalomyelitis in a mounted military police troop in Bihar. A preliminary report.

LAKSHMI SAHAI, Patna.

A description is given of an outbreak of Equine Encephalomyelitis in a mounted military police troop at Jamshedpur in Bihar, during which eleven horses were attacked, of which two recovered, two died and the rest were either destroyed or their destruction is contemplated.

The clinical features of the outbreak, the post-mortem findings and the histopathology of the lesions are described.

Chemical examination of the grass failed to reveal the presence of any poison.

Brain material from a case on sub-dural inoculation proved non-infective to rabbits but infective to guinea-pigs of which one died after showing paraplegic symptoms and another recovered after a febrile reaction.

A similar attempt in a horse using the intrathecal route failed.

The positive transmission results in guinea-pigs are interpreted to mean that the disease is probably of virus origin identical with the outbreak which occurred at Multan in 1933.

Finally, the relationship between Kumri and Equine Encephalomyelitis is discussed and stress laid on the epizootological and histopathological similarity existing between the two and the view is advanced that further research may perhaps show the two diseases to be due to a common etiological factor, such clinical differences as there may be between the two depending upon the differing elements in the central nervous system involved.

29. The incidence of *Salmonella enteritidis var. dublin* in pyosepticæmia of calves in India.

V. R. RAJAGOPALAN, Muktesar.

An organism isolated from cases of pyosepticæmia in calves, by Mr. Shirlaw at Lahore, has been typed as *Salmonella enteritidis var. dublin*, after a detailed study of its morphological, cultural and biochemical properties, as also of its antigenic constituents. Its antigenic structure has been found to be IX : gp : –., by a series of serological analysis. This is the first time that the incidence of this organism is recorded in India.

30. The incidence of *Corynebacterium equi* in a buffalo-cow.

V. R. RAJAGOPALAN *and* V. R. GOPALAKRISHNAN, Muktesar.

C. equi has been recognized by several workers as a cause of pneumonia in equines. It has not so far been recognized as occurring in any other species of animals. Its incidence in a buffalo-cow is therefore recorded in this article. Its identity with *C. equi* has been proved by morphological, cultural, biochemical, serological and biological tests. The significance of its incidence is discussed and it is held to be, at least, an etiological factor of post-abortion metritis, if not of abortion.

31. Neurolymphomatosis in poultry.

P. M. N. NAIDU, Hebbal (Bangalore).

The paper embodies the result of a preliminary study of this very interesting disease of poultry in Mysore.

The different manifestations of the disease in the fowl and its histopathological picture are described in detail.

Arguments are advanced on the strength of experimental evidence, incriminating some deficiency, most probably that of Vitamine C, as the possible etiological factor in this disease.. It is possible that under certain conditions the tissues are unable to synthesize their requirement of this vitamine from its precursors, setting up metabolic disturbances of and inflammatory changes in the tissues involved resulting in a lymphocytic infiltration in them which is characteristic of the disease.

32. Diseases of the egg-laying apparatus of the hen.

P. M. N. NAIDU, Hebbal (Bangalore).

The most important organs of the domesticated hen, viz. the ovaries and oviduct, which are intended for the formation of the egg and its normal passage to the exterior, are subject to a variety of disease processes described in this paper.

The practical importance of a correct and early diagnosis of these conditions to commercial poultry farming is stressed upon.

33. Leg weakness in poultry.

P. M. N. NAIDU, Hebbal (Bangalore).

Leg weakness in poultry as a result of some constitutional disturbance in the fowl set up during the course of certain diseases is discussed under the following agencies causing them:—

1. Internal parasites.
2. Nutritional disturbances.
3. Infectious diseases.
4. Diseases of doubtful etiology, chief of which are—
    - (*a*) Neurolymphomatosis,
    - (*b*) Osteitis deformans,
    - (*c*) Rheumatism,
    - (*d*) Gout, etc.

34. Some common poultry ailments encountered in the Mysore State.

P. M. N. NAIDU, Hebbal (Bangalore).

Experience gathered during a period of about two years' study of the most common diseases fatal to poultry in the State, with special reference to their occurrence, etiology, symptoms and differential diagnosis is described in this paper.

35. A controlled epidemic in Guinea-pig colony.

K. D. MANOHAR, Bombay.

While supervising the animal house the writer had an opportunity of studying the ecology of an epidemic in guinea-pigs. The epidemic, though natural as far as importation of the virulent organism was concerned, occurred in a controlled colony, in which, as a control measure, isolation of the healthy and susceptibles was immediately carried out, and also the destruction of the obviously sick animals.

The epidemic therefore resembles a human epidemic more or less modified by the active interference of health authorities.

Weather considerations were important. After a very hot spell rains set in violently. The animal house leaked badly and the animals were soaked through. Feeding was naturally unsatisfactory, the food getting sodden and dust-laden within a few hours of distribution. The rapid decomposition of food must also have diminished the available food considerably. Flies had come in swarms. Such was the condition of animals when the epidemic broke out. The first impression was that the food was the source of infection. But food was ruled out as a possible factor by the observation that isolated animals in cages completely escaped the epidemic, although fed on the same food stock. In addition to being isolated in cages, these animals were housed in well-protected rooms. Secondly, on post-mortem examination of animals, the intestines did not show inflammatory change while the lungs were definitely hæmorrhagic and showed broncho-pneumonia patches.

Discussing the subject with Dr. Gharpure, of Grant Medical College, he pointed out that Broncho-Pneumonia was often the cause of death in groups of guinea-pigs.

The attending *hamal* also informed that every rainy season, an epidemic did occur and killed off almost half the animals.

36. A preliminary report on the viability of *Mycobacterium paratuberculosis enteritis* under conditions simulating those in the field.

P. C. Banerji *and* K. Raghavachari, Muktesar.

A perusal of the available literature on Johne's disease shows that there is no authentic information on record concerning the viability in nature of the specific bacilli of the disease. As the elucidation of this point is obviously essential for the purpose of applying measures of control on a rational basis, a series of viability tests were carried out upon *Mycobacterium paratuberculosis enteritis* which were found in the fæces of a cow affected with Johne's disease four years after the fæces had been maintained under conditions simulating those obtaining in the field. Most of the organisms have undergone considerable morphological changes, but multiplied readily and regained their normal form when cultured in suitable media.

37. Cysteine hydrochloride as a suitable reducing agent in glucose broth for obtaining cultures of *Clostridium chauvoei* for the routine production of blackquarter vaccine.

V. R. Rajagopalan, Muktesar.

The prophylaxis of blackquarter with the aid of spore cultures in the form of dried and heated muscle pulp, and with the natural and artificial aggression has given place, in recent years, to vaccination with formalized cultures.

For obtaining massive growths for the purpose, glucose broth containing pieces of autoclaved meat, pieces of sterile tissue or the heart of inoculated guinea-pig was first being used. This had the disadvantage that débris from tissue used for creating anærobiasis became mixed with the bacterial emulsion. Mc. Even (1926) introduced a device by which bacterial emulsion could be obtained free of all tissue débris. He used a diffusion shell to contain the minced pieces of liver. Sheather (1928) replaced the diffusion shell with a porcelain cell.

This article records the results of a preliminary investigation into the possibility of substituting cysteine hydrochloride for tissues for the creation of anærobiasis. A freshly made solution of cysteine hydrochloride was added to glucose broth to give the required concentration. As small a concentration as 0·01% was sufficient to produce anærobiasis, provided a layer of paraffin was superposed. If a higher concentration was used (0·05 to 0·1%), the paraffin layer could be dispensed with.

A test was made of the prophylactic value of the formalized vaccine made from cysteine hydrochloride broth cultures that had been grown for two days and fourteen days, as well as of filtrates made from them. All the eight bulls and six guinea-pigs vaccinated with the vaccine withstood a retest with a lethal dose of *Cl. chauvoei* culture. Seven of the eight bulls and five of the six guinea-pigs treated with the filtrates withstood a retest inoculation. All the control bulls and guinea-pigs (two of each) died of typical blackquarter. In a second test, the cysteine hydrochloride broth vaccine was found not to be inferior to vaccines made from media containing tissues.

It was found incidentally that a strain of *Cl. chauvoei*, which had been in subculture for a long time, was capable of growing in simple glucose broth, without further anærobiasis. It was non-virulent for bulls, but a preliminary test showed that it retained its immunizing properties.

38. Studies on a natural outbreak of pigeon pox.

R. L. KAURA *and* S. GANAPATHY IYER, Muktesar.

A natural outbreak of pigeon pox occurred in a stock of healthy pigeons at this Institute and the source of infection was not traceable. The causative agent was demonstrated to be a filtrable virus and has been maintained by passage through pigeons. This appears to be the first recorded outbreak in India.

Immunological tests of the virus isolated indicate certain degree of antigenic variations from the English strain of pigeon pox virus obtained for comparison, although both are similar on grounds of pathogenicity and their capability to protect fowls against fowl pox.

Preliminary complement fixation tests showed that complement fixing bodies were rarely demonstrable in the sera of healthy as well as pigeon pox immune birds.

39. Actinomycosis and actinobacillosis in animals in India.

M. Y. MANGRULKAR, Muktesar.

Examination of recent specimens received at the Imperial Veterinary Research Institute indicated the prevalence, although apparently rare, in India of conditions which show lesions histopathologically indistinguishable from, or closely simulating, those of Actinomycosis and Actinobacillosis. This led to a thorough microscopical re-examination of all specimens from March 1922 to August 1937 and to the preparation of the present paper with the object of recording lesions wherein 'actino' bodies have been produced due either to a Gram positive mycelium or to Gram negative micro-organisms. Although no facilities for cultural examination were forthcoming nor was a complete clinical history available in every case, it seems certain that in India both types of infection occur. A case of canine actinomycosis is included. It is hoped that the attention of veterinarians in India will be drawn towards these conditions and that the desired scientific data will be made available in future.

40. Melanomata in domesticated animals.

M. Y. MANGRULKAR, Muktesar.

The paper is a histopathological study of the melanomata in the collection of the Imperial Veterinary Research Institute and includes a detailed clinical record of an equine case. Comparison is made between animal and human melanotic tumours, and the nomenclature is discussed.

Serology

41. Preparation of dried anti-rinderpest serum by alcoholic precipitation and desiccation *in vacuo*.

R. L. KAURA, Muktesar.

The active fractions of anti-rinderpest serum, special and ordinary, consisting of antibodies and the serum proteins, precipitated by 30 per cent. alcohol at 0°C. and desiccated after filtration, over phosphoric anhydride *in vacuo*, have been found to be practically equal in weight per volume of serum. When subsequently redissolved in normal saline solution to the original volume, the precipitate suspension, entirely soluble, was found to produce a protective effect on hill bulls equal to that of the original serum, thus indicating that the entire active principles of the serum had been precipitated. Moreover, it was determined that the immunizing value of the dissolved precipitate depended directly upon the rate of dilution.

42. Changes in phosphorus and calcium content of blood during rinderpest syndrome in hill bulls.

R. L. KAURA, Muktesar.

Daily variations in the phosphorus and calcium fractions of the blood during rinderpest syndrome in hill bulls, from the day of inoculation to death, or in the case of recovery for fourteen days after the inoculation, have been made. The normals for each animal under experiment were previously obtained.

It has been found that, during the rinderpest syndrome in hill bulls, there is a fall in the blood phosphorus which corresponds with the degree of reaction and a subsequent rise on the subsidence of reaction. There appeared a tendency for the blood phosphorus to rise sharply prior to death. The calcium level remained practically unaffected throughout.

Intravenous injection of sodium phosphate into hill bulls 48 and 72 hours after inoculation with rinderpest virus, resulted, within 15 minutes, in the increase of blood phosphorus lasting for about an hour followed, in about 6 hours, by a marked decrease and again coming up to the normal level by the 48th hour, without upsetting the blood calcium to any marked extent. It had no curative effect on the infected animals.

Helminthology

43. Helminthology in relation to Veterinary Science.

H. D. SRIVASTAVA, Muktesar.

The importance of helminthology in the conservation of public and animal health is often not fully realized, as the common symptoms of helminthiasis—a prolonged and progressive afebrile unthriftiness gradually resulting in death—are not always sufficiently spectacular to attract immediate attention. In this paper the author points out that in a tropical country like India, and one in which animal hygiene is little developed, helminthiasis is a most serious menace to the health of stock animals. The losses due to some of the important helminths are discussed and the urgent need of intensive research on the subject is indicated.

44. Helminth parasites of dogs—their treatment and control.

H. D. SRIVASTAVA, Muktesar.

The paper includes an account of the life-histories of the common helminth parasites of dogs. The pathogenicity, treatment and control of parasites are discussed. The importance of parasites of the dog in relation to public and animal health is pointed out.

45. Verminous pneumonia in domestic animals—its control and treatment.

H. D. SRIVASTAVA, Muktesar.

Verminous pneumonia is responsible for very high mortality amongst the domestic animals, specially sheep and goats, in several parts of the country. In spite of the high incidence of the disease no sure method of its treatment or prevention is known. In this paper the author discusses the life-histories, treatment and control of the important lungworms of domestic animals. The importance of proper feeding in fighting the infestation with lungworms is also discussed.

46. On a new species of *Psilorchis* Thapar and Lal, 1935, from the intestine of the common teal, *Nettion crecca.*

M. B. LAL, Lucknow.

Thapar and Lal (1935) described the genus *Psilorchis* from the intestine of a king-fisher. During the course of our investigations on the trematodes of birds, a few specimens were obtained from the intestine of a common teal at Ajgain. The present form differs from the existing species in the following features :—

1. Highly developed funicular testes.
2. Coalescence of the vesicula seminalis with the ventral sucker.
3. Extremely small pre-pharynx.
4. Shape of Ovary.
5. Nature of Vitellaria.

Full details of the anatomy of the trematode are given in the paper.

47. On a new trematode of the family Echinostomidæ from the spotted red-shank.

M. B. LAL, Lucknow.

Two mature specimens of trematodes were collected during the post-mortem examination of a number of spotted red-shanks at Lucknow. The trematodes which belong to the family Echinostomidæ present the following interesting features : cirrus sac dextral and not contiguous with ventral sucker, testes are not contiguous, uterus is much convoluted, and receptaculum seminis uterinum absent.

Full details of the anatomy and the systematic position of the form are discussed in the paper.

Pharmacology and Therapeutics

48. Effect of trypan-blue on goat blood virus.

P. G MALKANI, Patna.

Experiments carried out to determine how addition of trypan-blue to rinderpest goat blood virus affects its viability have shown that—

1. After addition of 1% solution of trypan-blue in 5% concentration, the virus, preserved (i) at cold storage temperature (36–40°F), is viable on the 14th but dead on the 21st day; (ii) at summer temperature (75–85°F), is viable on 2nd but dead on the 7th day; (iii) at winter temperature (60–75°F), is potent up to 11 days.

2. After addition of 1% solution of trypan-blue in 50% concentration, the virus, preserved (i) at cold storage temperature, is potent on the 7th but dead on the 14th day; (ii) at summer temperature (75–85°), is potent on 2nd but dead on the 7th day; (iii) at winter temperature (60–75°), may be potent even on the 11th day.

In view of these and author's previous findings that pure blood virus at cold storage temperature remains potent for as long as 22 days, it is concluded that the addition of trypan-blue shortens the period and that this 'shortening' appears to be directly proportional to the concentration of trypan-blue. The 5% concentration, however, leaves the viability unaffected for a sufficiently long time. If it gives similar results with bull virus it can be used for purifying it of Protozoan parasites in vitro and masking the colour of blood, so repugnant to the religious sentiments of the ryots.

Entomology

49. Observations on the bionomics of the ox warble-fly (*Hypoderma lineatum*).

B. N. Soni, Muktesar.

Observations carried out by the author since January, 1937, at the Imperial Veterinary Research Institute, Muktesar, have shown that over 50% of the hill bulls purchased for experimental purposes are infested with warble grubs (*Hypoderma lineatum*), and that it takes nearly 52 days for the larvæ to mature after their first appearance in the subcutaneous tissues of the animal's back. In two instances, the adult flies were successfully reared from larvæ that had been entrapped while in the act of escaping from the warble tumours. Evidence has also been obtained that the presence of these tumours results in a loss of condition of the affected animal.

In the writer's experience at Muktesar the occurrence of the oesophageal forms of *H. lineatum* was noticed first towards the end of March, 1937, and thenceforward they were encountered continuously during the observation period of about 5 months. The significance of the occurrence over such a long period is not understood and it would appear difficult to reconcile this finding with the generally accepted view that there is only one annual brood of *H. lineatum* in India.

The presence of warble tumours in dairy cows and of oesophageal larvæ in bulls born and bred at Muktesar shows that the pest is indigeneous to this locality.

The results of a short survey carried out in the Punjab have revealed the fact that in certain localities in that province the larvæ reach their final stage in the back by the end of September and no tumours in the back are noticed after the middle of January, while at Muktesar the larvæ in the back have been encountered as late as the beginning of March.

Immunology

50. Heredity and disease resistance.

F. A. E. Crew, Edinburgh.

The problem of resistance to disease is of great scientific interest and also of vital practical and economic importance. It is a complex problem demanding for its attempted solution the aid of the bacteriologist, the protozoologist, the physiologist and the geneticist together with others.

The degree of resistance, ranging from immunity to extreme susceptibility, depends upon a multiplicity of factors which may be grouped under the headings: environment, function and inheritance.

The evidence in favour of inherited predisposition to or relative immunity from disease is overwhelming, but the relative importance of heredity, function and environment still remains an unsolved problem.

51. Is lifelong immunity against rinderpest conferable on bovines ?

P. C. Banerji, Muktesar.

Two cows and a bull born of immune dams and reared at the Dairy of the Imperial Veterinary Research Institute, Muktesar, were immunised against rinderpest by the serum-simultaneous method using bull virus, at ages between 3½ months and 15 months. They were administered a second dose of the virus 7 to 9 days later and a third dose of 5·0 c.c. at periods ranging from 7½ months to 33 months after the initial inoculation. When tested for immunity by the subcutaneous inoculation of 5·0 c.c bull virus 6½ to 14½ years after their primary immunisations, all the three animals proved to be solidly resistant to the infection as was evidenced by the 'blocked out' reaction obtained in each case.

From the above experiment it may be concluded that animals immunised by the serum-simultaneous method followed by a dose of bull virus in reinforcement are liable to develop a lifelong immunity against rinderpest.

Biochemistry

52. Blood protein fractions in the normal, and vitamin A, calcium and phosphorus deficient bovines and equines.

N. D. Kehar, Muktesar.

A detailed study of the various changes in the protein fractions, consisting of total protein, non-protein nitrogen, albumin, total globulin, pseudoglobulin I, pseudoglobulin II, and euglobulin has been made in the blood of normal as well as of vitamin A, calcium and phosphorus deficient equines and bovines. Observations recorded so far, show that the antibody forming fractions of globulin are considerably less in the deficiency animals compared to the normal.

53. Vitamin A losses in hay and fodder conservation.

N. D. Kehar, Muktesar.

One of the most important problems in animal husbandry is the application of the best possible practice in conserving hay and fodder plants. Attempts have been made to find out the effect of different methods of conservation practised in India on the vitamin A content of grasses and other fodder plants. It has been observed that sun drying exerts a considerable influence on their vitamin A content.

54. Biochemical and physico-chemical factors in the etiology of bovine hæmaturia.

N. D. Kehar, Muktesar.

The different views about the etiology of hæmaturia are, as yet, not universally accepted. An investigation has thus been initiated into the biochemical and physico-chemical charactors of blood and urine of hæmaturia cows as a possible aid to help elucidating the evidence already available.

55. The rôle of mineral deficiency in equine abortions.

V. R. RAJAGOPALAN, Muktesar.

It is known that mineral deficiency may lead to abortion in certain farm animals. These abortions occur through starvation of the fœtus of essential minerals, through metabolic changes induced by disturbances of the endocrine system or through predisposition to infections.

The writer had an opportunity to investigate the cause of an outbreak of equine abortion. The possibility of infection with micro-organisms and intoxication with foodstuff was eliminated after a thorough examination. The analysis of blood serum revealed hypocalcæmia. The blood calcium ranged from 7·7 to 9·0 m.gm. per 100 c.c., as compared with an average of 12·3 m.gm. per 100 c.c in normal mares. This suggests that calcium deficiency was the cause of these abortions. This is corroborated by the following observations: This stud consisting of about forty brood mares used to suffer five to seven abortions per year before 1929. A mineral supplement came into use from 1929. Abortions disappeared from the farm simultaneously. The mineral supplement was discontinued in 1934. Two abortions occurred in 1935 and thirteen in 1936 up to the month of May. Hypocalcæmia was now detected, and a mineral supplement was reintroduced. The incidence of abortion has since practically ceased.

56. Investigations into the effect of mineral deficiencies on the resistance of ruminants to helminthic infestations, and the most practical method of combating the parasites.

U. W. F. WALKER, Lahore.

In this paper are incorporated the results of experiments carried out on the treatment of gastro-intestinal round-worms in ruminants. A number of drugs was tried, out of which a combination of copper sulphate and Kamala was found to be the most efficacious and cheap.

As a result of a series of controlled experiments it has been concluded that fodders deficient in minerals tend to lower considerably the resistance of ruminants to helminthic infestations.

Certain abnormal changes have been observed in the animals kept on unbalanced rations.

SECTION OF PHYSIOLOGY

President:—BT.-COL. R. N. CHOPRA, C.I.E., M.A., M.D., SC.D. (CANTAB.), M.R.C.P. (LOND.), F.N.I., F.R.A.S.B., F.S.M.F., I.M.S.

Honorary Physician to the King.

General Physiology

1. Normal gastric acidity in Indians.

L. EVERARD NAPIER, Calcutta.

Until recently it has been stated from time to time that the acid secretion in Indians living in India is lower than in Europeans, both in those living in hot climates and in temperate zones. In this paper, an attempt has been made to test the validity of this statement.

During the last year, a series of gastric analyses with alcohol test meal were done in the Tropical Diseases Hospital.

The general conclusion is that there is no lowering in the acidity level in Indians in India, and that, though a hot climate and a vegetarian diet are both said to be factors that tend to diminish gastric acidity, in actual fact this does not occur. On the other hand, there is some evidence that gastric acidity is actually increased.

2. On the composition of sweat of the Indians.

R. N. CHOPRA *and* A. C. ROY, Calcutta.

Analyses of a number of samples of sweat (free perspiration) collected from several normal individuals living in and around Calcutta were made with respect to some of the more important constituents. Widely varying results are reported by different workers. If the data presented by McSwiney be accepted as more or less representative of that obtained in temperate climates, our results show somewhat different values. The reaction of the sweat was invariably found to be acid, the pH varying from 4·6–5·7 (average 4·94); McSwiney reported a variation of pH 5·1 to pH 7·35 (average pH 61·14). The chloride content varied from 0·073 to 0·844% (average 0·44%) as against 0·37% (McSwiney). Ammonia-N varied from 7·5 to 34·2 mg. per 100 c.c. (average 19·3 mg.%) against 4·7 mg.% (McSwiney). The variation in urea N was between 10·4 to 61·5 mg.% (average 30·6 mg.%) against 20·44 mg.% (McSwiney). Only traces of phosphate could be detected. The majority of the specimens did not reduce 'indophenol' to any appreciable extent.

3. Effect of temperature variation on brain impulses.

R. N. CHOPRA *and* N. N. DAS, Calcutta.

The effect of changes in the temperature on the nature and character of impulses coming from the cerebral cortex was studied in anæsthetised animals with the help of an oscillograph and silver silver chloride electrodes. The changes were most marked in the action potential and in the frequency. Lowering of temperature lowers the potential of the impulses but makes them steady and uniform. Frequency is also lowered but is maintained uniform throughout. At higher temperatures, however, the action potentials of impulses are as a rule higher but they are never steady ; on the contrary they show fluctuations in amplitude and therefore in potential. The frequency also increases in such cases but they tend to lose their uniformity as the temperature is raised higher and higher.

4. Pigment studies in Indian and European skin.

L. M. GHOSH *and* D. PANJA, Calcutta.

Inhabitants of the tropics usually possess a darker skin than those resident in the sub-tropical and temperate zones. This is due to the presence of a pigment, melanin in the skin. As the presence of pigment in the skin is thought to play a part in tropical adaptation, an investigation was undertaken to see whether there is any quantitative or qualitative difference in the pigment present in the European and the Indian skin. A comparison of stained skin sections of the two races shows that the Indian skin has a greater concentration of melanin in the basal cell layer. The differences in the chemical composition of the pigment and the influence of other external conditions on the mechanism of pigment concentration are discussed.

5. Observations on the basal metabolism of healthy subjects under varying conditions of temperature and humidity.

BASHIR AHMAD, R. B. LAL, *and* N. C. RAY, Calcutta.

The American standards of basal metabolism though applicable in Europe and America require modification when applied to other regions. The reports of basal metabolism from Asiatic countries suggest a lower standard. The influence of climatic conditions on basal metabolism has also been studied and found to be lower in the tropics. However the exact rôle of racial and other factors, apart from the climatic influence, on the variation in metabolism still remains unsettled.

The present report is based on studies in basal metabolism of 9 young healthy Indians under two different sets of atmospheric conditions with regard to temperature and humidity, viz. the outside atmosphere during monsoon in Calcutta and the air-conditioned rooms in the Hygiene Institute, existing side by side so that the effect of sudden changes could be observed on the same subjects.

Our results show (i) the basal metabolism of each subject in outside atmosphere is lower than that of the American standards. (ii) The basal metabolism of all the subjects on going to the air-conditioned rooms from outside is still lower.

The data though meagre seem to suggest that individuals vary in their response to the atmospheric conditions.

6. The seasonal variation in basal metabolism.

S. A. RAHMAN, Hyderabad (Deccan).

Basal metabolism tests were made on 31 days on a single subject from September, 1936 to July, 1937. The results were strikingly uniform, most of the results being within 2 per cent. of the average. The average for the 31 days worked out as 12·1 per cent. below Harris-Benedict and 18·3 per cent. below Aub-DuBois standards.

There was no marked difference in the results obtained during the winter and the summer months. In fact, contrary to expectation, the results obtained during the summer months (May and June) were slightly

(2·5 per cent.) higher than those obtained during the winter months (November and December).

There was a slight but definite lowering of basal metabolism in the months of July as compared with the results obtained in May and June. The cause for this is discussed.

7. A note on the basal metabolic rate in Indians.

S. L. BHATIA, Bombay.

The Basal Metabolic Rate of a large number of Indians of different communities have been determined. The results obtained have been discussed.

8. Urinary composition of normal Bengali subjects.

S. N. ROY, Calcutta.

The average composition of the urine of middle-class Bengalees of normal health is given. The averages are based on the analyses of a large number of normal urines each collected over a period of twenty-four hours. It is found that total nitrogen, urea, inorganic sulphate, and calcium excretions are greatly lower, chloride excretion is definitely higher, and creatinine, uric acid, ethereal and neutral sulphate and inorganic phosphate outputs are more or less the same as compared with the corresponding figures for normal European or American subjects on ordinary mixed diets. The significance of these findings are discussed.

9. The electrical charge of carbon particles and their phagocytosis by polymorphonuclear leucocytes.

S. N. MUKHERJEE, Calcutta.

Attempts have been made to correlate the electrical charges on carbon particles suspended in different concentration of sodium chloride with their percentage phagocytosis under corresponding conditions, keeping the osmotic pressure of the suspending media constant and equal to that of normal saline by the introduction of calculated amounts of glucose and M/15 phosphate buffer of pH 7·3.

Surface charge of negative particles has been observed to diminish with increasing concentration of sodium chloride in medium and a slight reversal of charge at higher concentrations were also observed. The percentage of phagocytosis increased with the diminution of negative charge and reached a maximum value near about the neutral point of the carbon particles which was observed at a concentration slightly lower than 0·85% sodium chloride solution.

10. The elasticity of the lung.

B. B. SARKAR, Calcutta.

In a previous work, the author while attempting to demonstrate the pressure variations in the alveoli found that the elastic recoil of the lung, as determined by the differences of pressure between the inside and outside of the lung, does not increase, as is supposed, with the distension of lung. The present work was undertaken to determine the elastic recoil of the lung under different conditions of distension.

The negative pressure, (in the air-tight chamber encasing the animal), which is keeping the lung inflated when the intrapulmonary pressure is kept normal, being the elastic recoil, was recorded. When the pressure outside the lung wall (in the chamber) in an inflated lung is made equal to the atmospheric pressure, the distended lung wall raises the intrapulmonary pressure by an amount equal to its elastic recoil, which was also recorded.

In every case the results of the experiments on the lung were compared with the results obtained by using a thin-walled rubber balloon and a thick-walled football bladder in the same way.

From the results of these experiments it has been found in every case that, like other substances having elastic properties, those elastic membranes show an increasing elastic recoil when just getting distended, but soon reach a limit beyond which further recoil is not possible. In the rabbit the elastic recoil in the inflated lung was found to be about 50 to 55 mm. of water.

11. The part played by the elasticity of the lung in respiration.

B. B. Sarkar, Calcutta.

In the previous paper it has been demonstrated that the elastic recoil in the distended lung remains unaltered. In the present paper an attempt has been made to find out the part played by this property of the lung-wall in normal respiration.

In normal respiration the lung-wall is kept in close contact with the thorax wall, by a negative pressure in the intrapleural space which is equal to elastic recoil of the lung. The natural tendency of the lung to collapse is thus just prevented by this amount of negative pressure, resulting in the lung-wall behaving as an inert membrane, being, as it were, balanced by two equal and opposite pressures. Consequently any pressure differences which are created inside the lung (alveoli) as the result of inspiratory and expiratory movements are readily transmitted to the intrapleural space. It has been found that when the intrapleural pressure is reduced beyond the elastic recoil value of the lung, causing an active pull on the lung-wall, the respiratory variations of the intrapleural pressure cease altogether. They start again when the elastic recoil of the lung is again balanced, as by increasing the intrapleural pressure to its former (elastic recoil) value or by proportionate reduction of the intrapulmonary pressure.

Experimental lowering or raising of the intrapulmonary pressure correspondingly lowers or raises the intrapleural pressure.

12. On the osmotic relationship between egg-white and egg-yolk and the effects of injection of potassium cyanide and sodium fluoride on it.

N. M. Basu *and* M. C. Mitra, Calcutta.

These experiments were undertaken to find out if the difference in osmotic pressure between egg-white and yolk as observed previously by Straub and by Hill is due to Donnan membrane equilibrium or the vitality of the vitellin membrane separating yolk from white. If the difference be due to Donnan membrane equilibrium, injection of substances like KCN or NaF will not disturb this equilibrium ; if due to vital activity of the membrane, the reverse result will take place. It was found that after the injection of both KCN and NaF in suitable concentrations, the difference in osmotic-pressure gradually diminished, although there was no change in osmotic-pressure in the control eggs in the same period. The marked diminution in the difference of osmotic-pressure cannot be wholly explained by the addition of osmotically active substances caused by the injection of KCN and NaF.

13. Experiments with choline.

W. Burridge *and* D. N. Seth, Lucknow.

The action of choline in dilutions varying from one part in 10^{2} to one part in 10^{-14} has been studied on the perfused frog's heart. The drug is added to a perfusing solution containing too little calcium to maintain cardiac activity for more than half an hour and the effect of the drug is observed by noting its power to depress or stimulate the activity of such a preparation. Choline acts as a cardiac depressant between dilutions 10^{-2} to 10^{-8}. No action is elicited when a dilution of 10^{-9} is used. The cholinised heart not only recovers completely from the depressant effects after washing but also shows an indefinite prolongation of activity. This maintenance-capacity of choline has been assumed to be due to its entering into some firm chemical combination with some constituent of heart muscle. Certain theoretical implications of the depressant action of choline on nerve-cells are also discussed.

14. Variation in the absorption of drugs from the gastro-intestinal tract.

B. Sen, Calcutta.

Drugs possessing reputed therapeutic properties have not infrequently been found to show variations in their effectiveness. The efficacy of a drug is mainly dependent on the normal physiological process of absorption but this is very likely to be disturbed to a considerable extent by any abnormality in the secretions of the gastro-intestinal tract, the intestinal flora, the peristalic movements, the conditions of the gall-bladder and the appendix.

Hæmatology

15. The normal blood picture in Indians.

L. Everard Napier, Calcutta.

The normal blood picture of Indians in Calcutta has been studied and compared with the normal blood picture of the people of temperate and cold climates. It has been shown that there is no gross difference in the hæmoglobin or cellular content of the blood in Europe and India; if anything, contrary to previous teaching, the hæmoglobin is higher in India. With the possible exception of the higher eosinophilic count, the differences that have been observed have no pathological explanation.

The blood picture of the so-called normal coolies in tea-garden labour forces is also investigated. It has been shown that the mean hæmoglobin is much lower than that of the city-dwelling Indians though the number of red cells is about the same. It is pointed out that this low level of hæmoglobin cannot be considered to be due to climatic or racial factors but is probably associated with diet and subclinical infection, e.g., hook-worm infection.

16. Hæmoglobin in relation to food requirements.

G. Sankaran, Coonoor.

It is usual in nutrition to relate food requirements and body-weight. From a physiological point of view, this may be irrational. Two individuals, one thin and the other fat, may have similar amounts of metabolising tissue, and their total energy requirements may be similar though requirements per kilo. are different. There is still another factor to be considered—the capacity of tissue to utilize nutritive elements. Leaving pathological conditions out of consideration, the capacity of tissues in this respect must be dependent on the oxygen present, and hence will be influenced by the amount of oxygen carried—i.e., hæmoglobin—in the body.

The amount of oxygen required for 'burning' different foods and the amount of hæmoglobin in circulation needed to carry this amount of oxygen, are considered. Data are presented showing that, in a series of individuals, there was no relation between weight and the hæmoglobin content of the blood.

It is concluded that the latter should be taken into account in considering food requirements. Ill-nourished individuals are usually anæmic. It may be necessary to correct their anæmia before they can fully utilize a richer diet.

17. Mean red-cell diameter of South Indians.

G. Sankaran *and* M. V. Radhakrishna Rao, Coonoor.

A study of the mean red-cell diameter of South Indians was undertaken by a modified area method with a view to establishing normal standards. The method is simple and less time-consuming than the original Price-Jones' method. Data are presented of 25 cases, including both males and females. A statistical analysis of the data showed for South Indians a mean red-cell diameter of 6·85 microns, with a standard deviation of 0·28 microns, and coefficient of variation of 4·1 per cent. These figures show that the mean red-cell diameter of South Indians is somewhat smaller than that given by Price-Jones (7·202 microns) for Europeans.

18. The Arneth count in tropics.

Dharmendra, Calcutta

The results of the Arneth counts of fifty apparently healthy Indians are reported. The counts show a left-handed shift as compared to the standard in Britain. The counts are shifted to the left nearly to the same extent as in the case of Iraquis and Chinese. They do not show as much left-handed shift as do the counts of Alonites in North Syria.

The shift does not appear to be due to any active or latent infections of a minor degree in apparently healthy individuals or to any racial or dietetic factor. It appears to be dependent on some environmental factor or factors which are common to the tropical and subtropical countries. Not much is known about the nature of these factors or about the way in which they bring out this left-handed shift.

19. A hæmoglobin constant.

S. S. Sokhey *and* Malandkar, Bombay.

For a hæmatologic study of 121 normal men and 101 normal women of the Bombay Province, between the ages of 18 and 30 years, all the hæmoglobin estimations were made with the Van Slyke's Oxygen capacity method. An average of 15·37g. of hæmoglobin per 100 c.c. of blood for men and an average of 12·99g. for women were obtained. These averages tallied exactly with hæmoglobin averages for men and women worked out in United States of America by the same method, (Men—Haden, 15·37g.; Dill, 15·36g.; Women—Haden 12·93g.), in spite of the fact that dietetic habits and the climatic conditions under which the Indian and American subjects lived were so dissimilar. This observation raised the question of a possible hæmoglobin constant. A study has been made and results are presented.

20. 'Spring' of hæmoglobin.

S. N. Mathur, Lucknow.

As a result of experiments done on healthy medical students, it has been found out that the percentage of hæmoglobin shoots up in the spring months. Man in this respect appears to be in sympathy with the rest of the nature.

21. Hæmoglobin level of Indians at an altitude of 6,000 feet above mean sea-level.

G. Sankaran *and* K. Rajgopal, Coonoor.

A study on the hæmoglobin content of the blood of 20 male Indians in Coonoor (at a height of 6,000 feet above sea-level) has been carried out, using the Van Slyke apparatus for determining the oxygen capacity of blood. The average figure of hæmoglobin was 16·45 grms. per 100 c.c. Don and Jenkins give the average of 118 English males as 15·85 grms. per 100 c.c. Price-Jones, Vaughan and Goddard give 14·71 grms. hæmoglobin as the average for 100 English adults. Napier found an average of 14·77 grms. hæmoglobin in 50 Bengalees. The altitude factor is probably responsible for the relatively high hæmoglobin content in Indian at Coonoor.

22. The normal polynuclear (Arneth) count at Hyderabad (Deccan).

S. A. Rahman *and* M. A. Zaidy, Hyderabad (Deccan).

Eighty-eight healthy men at Hyderabad (Deccan), from 15 to 45 years of age, were examined for the total white cell count and the polynuclear (Arneth) count. The total count varied from 4,000 to 13,100, the average being 7,128. The average weighted mean of the polynuclear count was found to be 2,442. This figure is slightly lower than that obtained by Kennedy in Scotland, and still lower than the figures obtained by Cooke and Ponder. The probable causes for the low results at Hyderabad have been discussed.

23. Diurnal variation in the white cell count in the tropics.

C. R. Das Gupta, Calcutta.

It has been shown by workers in Europe and America that there is a great diurnal variation in the white cell count in the normal healthy individuals at rest and that this variation is independent of the digestive processes. These observations have been confirmed by the writer in a series of healthy volunteers whose blood counts were recorded every hour during the day. The count usually reached a maximum in the afternoon.

In eight habitual foot-ball players whose blood was examined before and after a game of strenuous foot-ball in the summer, no marked leucocytosis was seen in any case after the game. The diurnal variation in the leucocytes as also the leucocytosis observed under various physical and psychical conditions, e.g. exercise, fear, etc., is due to re-distribution of cells from stagnated viscera to the periphery and as such, is not accompanied by any departure from the normal leucocytic formula in the Arneth count.

Pharmacology

24. Hæmolytic action of some hydrocupreidine derivatives.

R. N. Chopra, B. Mukerji, *and* M. Chakravarty, Calcutta.

The alkyl ethers of hydrocupreidine have all been synthesized by Ghosh and Chatterjee (*Jour. Ind. Chem. Soc.*, 8, 257; 9, 83). A comparative study of the hemolytic potency of these compounds with their corresponding levo-rotatory isomers and quinine has been made in this paper.

Red blood corpuscles of rabbits and human beings were made plasma-free by repeated washings and centrifugalization and suspended in physiological saline. To this, equal volumes of different concentrations of Hydrocupreidine and Hydrocupreine salts were added, taking special care to see that the *p*H of the solutions were maintained within the constant range of 5·6 to 6·3. Two series of observations were made: (1) The minimum time for starting of hemolysis, keeping the concentration of the different salts constant, and (2) the minimum concentration just necessary to produce hemolysis, by keeping the time of exposure of the corpuscles to the different dilutions constant. The quantitative hemolytic potency of the different compounds in terms of quinine has been calculated from this latter observation. It was found that the dextro-rotatory hydrocupreidine derivatives were stronger hemolytic agents than quinine, the hemolytic potency increasing steadily as the higher homologues were reached (*n*-Octyl Hydrocupreidine about 100 times stronger than Quinine Hydrochloride). The addition of serum diminishes the hemolytic potency to a very large extent. The levo-rotatory hydrocupreines are almost identical in action to the dextro-rotatory isomers, as far as the hemolytic activity is concerned.

25. Comparative action of hydrocupreines and hydrocupreidines on digestive enzymes. Part I. Carbohydrate digestion.

B. MUKERJI *and* N. K. IYENGAR, Calcutta.

The comparative inhibitory action of a series of dextro-rotatory hydrocupreidine derivatives and their corresponding levo-rotatory isomers on salivary and pancreatic amylase and on yeast invertase was studied. Quinine has been taken as the standard for comparison.

The method of Willstatter, Waldschmidt-Leitz and Hesse (*Z. physiol. chem.*, 126, 143, 1923), based on the determination by iodometric titration, of the amount of reducing sugars formed after the reaction, was employed. The particular compound to be tested was added in a concentration (0·1%) which is approximately equivalent to the concentration in the digestive secretions, of a therapeutic dose (10 grains) of quinine. The reaction mixtures were maintained under the optimum conditions with regard to temperature, *p*H, etc. for enzyme action. Contrary to previous reports, the levo-rotatory hydrocupreines were found to be far more powerful inhibitors to the amylases than the dextro-rotatory hydrocupreidines. Quinine comes in between the two groups, being generally weaker than the higher members of levo-rotatory hydrocupreines but stronger than the dextro-rotatory hydrocupreidines. The lower members of the hydrocupreidine series do not appear to possess any inhibitory action at all on invertase activity while the higher homologues are definitely more potent in this regard. The possible mechanism of this inactivation has been discussed.

26. Studies on the effects of some cardiac drugs on heart explants.

R. N. CHOPRA, N. N. DAS, *and* B. MUKERJI, Calcutta.

It has been noticed (Murray, 1934) that fragments of heart tissue from Chick embryos (6 to 8 days old) if kept in a nutrient medium containing homologous plasma and embryonic extract, exhibit certain characteristics in the nature of their throbbing and their growth. In the present investigation, the effects of a few well-known cardiac drugs, e.g. lanadigin (crystalline glucoside of *D. lanata*), thevetin (crystalline glucoside of *T. neriifolia*), ouabain (crystalline glucoside of *G. strophanthus*), caffeine and cardiazol, on these heart explants were studied in the hope that the observations on such simple, nerve-free embryonic preparations would throw light on the true mechanism of their action on heart tissue.

The effects on both the (1) fibroblastic growth of cells and the (2) rate of throbbing of the heart tissue were recorded. It was found that both lanadigin (1 : 500,000) and thevetin (1 : 50,000) stimulate the fibroblastic growth of tissue cells but inhibits the rate of beat of the heart explants. Strophanthin (1 : 4,000,000) does not seem to possess any stimulant effect on the tissue growth but brings about a definite inhibition in the rate of throbbing. Caffeine (1 : 50,000) and cardiazol (1 in 50,000) are both stimulants to the growth of tissue cells as well as to the rate of beat of the cardiac explants. Caffeine further seems to prevent the normal occurrence of fatty degeneration in these explants and maintains the beats for a longer period than the controls kept under identical conditions. The theoretical implications of these interesting results are discussed.

27. Pharmacological action of 'skimmianine'—an alkaloid obtained from *Skimmia laureola*.

R. N. Chopra, G. S. Chopra, *and* J. C. Gupta, Calcutta.

An alkaloid skimmianine has been isolated from the leaves of *Skimmia laureola*, a glabrous shrub belonging to natural order Rutaceae. The alkaloid is insoluble in petroleum ether, sparingly soluble in ether and cold absolute alcohol, soluble in hot alcohol and readily in chloroform. The purified alkaloid is obtained is yellow rhombic octahedral crystals melting at 175°–176°C.

The important pharmocological effects of this alkaloid are the rise of blood pressure, inhibition of the tone and movements of the plain muscles of the intestine and constriction of bronchioles. These effects appear to be due to stimulation of sympathetic. It is observed that the action of this alkaloid on the sympathetic is predominant in the case of heart and intestine.

28. Antagonism of ergotamine on adrenalin.

B. Narayana, Patna.

The action of ergotamine on the vessels of the hind limbs of the frog was investigated. The results show an uncertain action of the drug on the preparation. Perfusion with adrenaline following ergotamine causes vaso-constriction. There is no evidence that the action of adrenalin is suppressed or reversed by ergotamine.

29. On the influence of adrenalin and acetyl-choline on the effects of calcium and potassium ions on the onset of fatigue in skeletal muscles of frog.

N. M. Basu *and* G. C. Mukherjee, Calcutta.

Skeletal muscles of frog were kept bathed in a muscle trough filled with Ringer's solution and stimulated repeatedly by means of a neon-lamp stimulation unit. The effects of adrenalin and acetyl choline and of calcium and potassium ions in different concentrations on such preparations were noted. The results are as follows :—

(*a*) With Ca and adrenalin lack, fatigue is delayed but the contractions are weak and the contraction remainder is slight.

(*b*) Addition of adrenalin or sub-normal amounts of $CaCl_2$ makes the contractions more powerful and causes an early onset of fatigue, whereas, the addition of both causes still more powerful contractions and an earlier onset of fatigue.

(*c*) With further increase in $CaCl_2$ concentration the contractions become more marked but fatigue is delayed. Addition of adrenalin augments these effects.

(*d*) If the concentration of $CaCl_2$ be five times the normal amount, then also the augmented contractions and delayed fatigue are noticed but the addition of adrenalin quickens the onset of fatigue.
(*e*) With K lack, contractions are strong and fatigue is delayed. Addition of KCl quickens the onset of fatigue in proportion to the amount added, but the addition of acetylcholine helps relaxation and delays the onset of fatigue.
(*f*) If the concentration of KCl be nine times the normal amount both contractions and relaxations are reduced, the former more than the latter and the onset of fatigue is much quickened. The addition of acetylcholine to the solution delays the onset of fatigue.

30. On the influence of Ca and K ions on the effects of adrenaline and acetylcholine on frog's heart.

N. M. Basu, S. K. Mahalanobis, M. C. Mitra, *and* G. G. Banerjee, Calcutta.

The effects of adrenaline and acetylcholine and the manner in which these effects are modified by the presence or absence of different concentrations of calcium and potassium ions were observed in perfused frog's heart. The results obtained are stated below :—

(*a*) In Ringer deficient in Ca, the heart-beat stops after some time, but the addition of adrenaline prevents this stoppage of heart beat. This action of adrenaline is not seen when an excess of calcium is added to the perfusion fluid.
(*b*) In the absence of Ca acetylcholine is quite effective but with the addition of increasing quantities of Ca the effect of acetylcholine becomes less and less evident. In the absence of potassium however the acetylcholine action does not take place readily.
(*c*) If the vagus nerve is stimulated by a weak and rapidly intermittent current while the heart is being perfused with calcium-free Ringer solution the heart beat is slowed and reduced. The effect of vagus stimulation is not noticeable if a small amount (subnormal) of calcium is added to the perfusion fluid.
(*d*) In potassium free Ringer solution adrenaline augments the heart beat but makes the heart stiff, but with the addition of K, the augmentation effect of adrenaline is less marked and the stiffness of heart does not result.

31. On the effects of adrenaline, histamine, phloridzin and cobra venom on blood vessels.

N. M. Basu *and* G. C. Mukherjee, Calcutta.

These experiments were performed on frogs by the vessel perfusion method which has been slightly modified in accordance with the needs. The rate of outflow was measured by a thermionic drop recorder and tracings were taken. The known effects of adrenalin were compared with those of phloridzin, histamine and cobra venom. It was found that whereas adrenalin brings about immediate constriction of blood vessels, phloridzin causes constriction after some time. The effect of adrenaline is temporary but phloridzin effect is more lasting. Histamine brings about vaso-dilatation immediately and this effect is temporary. Cobra venom has no effect on the tone of blood vessels.

Biochemistry

32. Total ascorbic acid content of human blood.

S. K. Gokhale, Bombay.

The blood of eighty normal young Indian males has been examined for the total ascorbic acid content. The method of Mirsky, Swadesh, and Soskin (Proc. Soc. Exp. Biol. Med; 1935, *32*, 1130) was used. The procedure converts any oxidised material into the reduced form and this enables the determination of the total content of ascorbic acid present in the reduced form. Fasting blood samples were used. The values obtained gave a mean average of 1·80 mg. per 100. c.c of blood, with a range of 1·20–2·54 mg. per 100 c.c. The subjects were young medical students mostly from the Bombay Presidency of ages between 18 and 32 years. The results obtained showed that the mean total ascorbic acid content of those on vegetarian diet did not differ significantly from that of those on mixed diet.

33. Actinomyces—their biochemical reactions as aids in their classification, Part I. Reduction of nitrates.

L. M. Ghosh, S. Ghosh, N. R. Chatterjee, *and* A. T. Dutt, Calcutta.

The classification of the group of micro-organisms, generally designated as actinomyces, is still very unsatisfactory, and various authors have put forward various schemes of classification based on the morphology, clinical characters, physiological properties, etc. A study of the biochemical property of the reduction of nitrates of about 31 species of actinomyces in Czapeck's synthetic liquid media, without the use of iron salts, has been made. These have been found to fall into three main groups. A modified scheme of classification is suggested and it is believed that further studies on this and other biochemical reactions will give more significant data for a better and more satisfactory classification.

34. Some biochemical findings in cases of anæmia of pregnancy and in normal pregnancies in Bengal.

H. N. Chatterjee *and* S. M. Ghosh, Calcutta.

Pregnancy anæmia in Indian women is not primarily a hæmolytic anæmia as shown by the Van den Bergh test and estimations of bilirubin although in the later stage of the disease the Van den Bergh test might indicate some amount of hæmolysis. The condition has a seasonal variation in Bengal. It starts with the rains and has the maximum intensity during the height of the rainy season.

It is possible that an excessively moist atmosphere interferes with the excretory function of the skin and thereby puts an additional burden on the kidney which has already to perform an extra amount of work in pregnancy. There is also a decrease of the serum albumin and the absolute increase of the serum globulin with a disturbed albumin : globulin ratio. This changes the osmotic pressure of the plasma and might be instrumental in the production of the associated œdema. The disturbed albumin : globulin ratio is also present in some of the normal pregnancy cases examined.

A very remarkable feature is the marked decrease in blood cholesterol (instead of the normal increase) which might inhibit the formation of the red cells of whose stroma it is an important constituent. There is a possible vicious circle and correlation between the low blood cholesterol and the retention of nitrogenous products and chlorides, in other words, between the bone-marrow and the kidney functions aggravating each other and resulting in progressive anæmia and œdema.

35. Some observations on the incidence of malocclusion of teeth in Indian children of all communities.

H. Ellis C. Wilson *and* D. D. Mitra, Calcutta.

The incidence of malocclusion including displaced and rotated teeth has been studied in some 3,000 children of both sexes. As regards the different communities the highest percentage was found among the Anglo-Indians followed by the Marwaris, Hindus and the Moslems. Taking any one community the highest incidence was observed among the poorer class. It would appear that probably diet alone is not the only factor. There does not seem to be any correlation between caries and malocclusion. In general those with malocclusion showed no signs of caries. In any one community of the same economic class there did not appear to be any difference between the sexes.

36. Glutamic acid dehydrogenase from germinating seeds.

Manayath Damodaran *and* K. Ramakrishnan Nair, Madras.

In view of the hypothesis recently advanced by Krebs on the part played by glutamic acid deaminase in the synthesis of glutamine in animal tissues, the existence of deaminases in seedlings was investigated, as in the latter, amide-synthesis is a well-established fact. A specific glutamic acid dehydrogenase has been detected in some seedlings of the leguminous family; but only in three out of a dozen species examined could its presence be demonstrated.

The enzyme belongs to the group of 'oxytropic dehydrogenases' reacting with substrate either in the presence of oxygen or of methylene blue. It can be obtained in cell free extracts and can be concentrated by precipitation with ammonium sulphate (full saturation). It has an optimum pH of 7·8 and is wholly inactive below pH 5·9.

In manometric experiments the rate of oxygen uptake is not influenced by hydrogen carriers like methylene blue, ascorbic acid, glutathione, or 1–3·4 dihydroxy-phenylalanine. Potassium cyanide or arsenite up to a concentration of ·002M has no inhibitory action, but with higher concentrations the oxygen uptake falls slowly though inhibition is not complete even at a cyanide concentration of 0·2M.

The oxygen utilised corresponds to one atom of oxygen per molecule of glutamic acid. The product of the oxidation has been shown to be α-keto-glutaric acid which was isolated as its 2·4-dinitro-phenylhydrazone.

37. The rôle of carotene in metabolism of fats. Part I.—Seasonal variation of Reichert value, iodine number, carotene and vitamin A contents of butter fats.

S. M. Das Gupta, Calcutta.

About 4 to 15 samples of butter fats prepared in each month were analysed for their Reichert value, iodine number, carotene and vitamin A contents. It was observed that the Reichert values and carotene contents on the one hand and iodine number and vitamin A contents on the other tend to be higher in the winter (November to February) than in the autumn (July to October). *Prima facie*, the results obtained are contradictory to the data obtained in western countries where the lowest Reichert values and carotene contents of butter fats have been obtained in the winter. The explanation of this is probably to be found in the grazing habits of the cattle in this country and the availability of grasses and leafy vegetables of high carotene content during winter.

38. The rôle of carotene in the metabolism of fats, Part II.

S. N. Das Gupta, Calcutta.

It is generally held that the first stage in the metabolism of fats is the desaturation of the fatty acids and then oxidation takes place by the well-known process of beta-oxidation. The constitutional formula of carotene at once suggests that it can act as a hydrogen acceptor in the process of desaturation or as an oxygenated compound in the process of oxidation. Moreover, Euler and his school consider that vitamin A is a reduced fragment of carotene. If such be the case, then the processes of desaturation and oxidation of fatty acids are closely connected with the carotene and vitamin A contents of butter fats. To test this dual function of carotene, feeding experiments have been carried on two healthy cows with rations of high and low carotene contents resembling those of the autumn and the winter feeding-stuffs. It has been found that by ingesting fresh grass of high carotene contents (3·6 mg. per 100 gm.) the Reichert value gradually rises (from 26·2 to 28·6) but again falls when the cows are again fed on hay. The results obtained are in close agreement with the hypothesis suggested above.

39. Investigation of vitamin B_1 and B_2 content of Soya bean (*Glycine hispide*) by biological method.

K. P. Basu *and* Md. Abdul Quader, Dacca.

Black type of soya bean was investigated in three percentages—15%; 25%; 40% in the diet for vitamin B_1 and B_2 determination by biological method. The value for B_1 has been found to be 165·59 international unit per 100 gms. of soya bean. Soya bean contains a fairly good amount of B_2. The behaviours of the individual rats on different percentages of soya bean content are shown in graphs.

40. Biological value of proteins of 'Arhar' (*Cajanus indicus*) and black gram (*Phaseolus mungo*, var. Linn) by balance sheet method and by growth of young rats.

K. P. Basu *and* Md. Abdul Quader, Dacca.

The biological values of 'Arhar' (*Cajanus indicus*) proteins by balance sheet method at 10 and 15% levels of protein conconcentration are 54 and 48 respectively, while those of *Phaseolus mungo* at the same levels are 75·8 and 65·9. The biological values thus decrease with increase of concentration of protein.

The protein values of *Cajanus indicus* at 10 and 15 per cent. levels of protein are 12·8 and 10·34 respectively while those of *Phaseolus mungo* are 21·44 and 17·08 respectively.

Growth per gm. of protein ingested at 15% protein concentration in the case of *Cajanus indicus* is 0·89 and of Phaseolus mungo 1·09, while that at 10 per cent. concentration in the case of *Cajanus indicus* is 0·69 and in the case of *Phaseolus mungo* 0·85.

41. Deficiency of calcium and phosphorus in average Bengalees.

S. K. Sen, Calcutta.

The amount of calcium in the serum does not throw any light regarding its amount in the bone reservoirs. In an average Bengalee adult its concentration in serum is nearly normal, but the bone shows a marked deficiency in both calcium and phosphorus. The estimation of calcium in human as well as cow's milk also gives figures lower than the accepted normal. The possible causes for such low figures have been discussed.

42. A comparative study of glycolysis in normal and diabetic blood.

PREMANKUR DE *and* SUKUMAR BHATTACHARYYA, Calcutta.

The rate of glycolysis in oxalated blood in normal and diabetic cases was studied. Glycolysis takes place in drawn normal oxalated blood at a rate of 3·83–6·50 mgm. per hour per 100 c.c. of blood (average 6·05 mgm. per hour per 100 c.c.) during the first 4-5 hours of observation. In oxalated diabetic blood, glycolysis proceeds at a rate of 4·0–16·6 mgm. per hour per 100 c.c. of blood (average 4·61 mgm. per hour per 100 c.c.) which indicates a depression of about 23·8 per cent. from the normal blood. This high rate however falls after 4 to 5 hours when glycolysis proceeds at a continuously decreasing rate.

43. Glycolysis in drawn blood in 24 hours.

PREMANKUR DE *and* SUKUMAR BHATTACHARYYA, Calcutta.

Complete glycolysis does not take place in 24 hours in oxalated blood. The percentage of sugar glycolysed is found to bear a more or less inverse ratio to the initial sugar concentration. Accumulation of lactic acid has been suggested as the probable cause of diminution of glycolysis in later periods.

The amount of non-glucose copper-reducing substances in blood has been found to be about 6–8 mgm. per 100 c.c. of blood.

44. The influence of ingestion of ascorbic acid on the vitamin C content of milk.

M. N. RUDRA, Patna.

It has been found that by allowing a goat to ingest large amounts of ascorbic acid (5 to 22·5 mgs. per kg. body weight), the vitamin C content of its milk could be raised by about 50 per cent. When the goat was put on a vitamin C free diet for 7 days, the milk was about normal in vitamin C content as during grazing. A dose of 50 grams. of glucose for 15 days now raised the vitamin C content of milk.

45. A study of the exchange of dissolved substances between a voluntary muscle and saline solutions.

A. GAFFAR, Nagpur.

When a muscle is immersed in a saline solution, an exchange of substances dissolved in saline and the muscle water takes place, till an equilibrium is established between the two. The composition of the saline, while keeping it osmotic with the muscle, may be varied by adding various substances to it, and thus the diffusion of various substances into and out of muscle can be studied. By suitable calculations, the ratio between the portion of muscle-water into (or out of) which a substance can diffuse, and the portion which does not allow such an exchange can be determined.

This method has been employed in studying the rate of diffusion of urea, bicarbonate, histidine, lactate, iodide, etc. through the living voluntary muscle of frog. The results indicate that these substances may be divided into two groups : (A) substances that can diffuse through the whole of muscle water, e.g. urea, histidine and carbon dioxide. (B) substances that can diffuse through a portion of muscle water (' interspace ' water) only but is unable to diffuse into the rest of it (' cell ' water). To this group belong lactate, iodide, chloride, bicarbonate, etc. Further, in every case it is found that ' interspace water ' forms about 1/3 and the cell water about 2/3 of the total muscle water.

46. The action of choline in the prevention of fatty livers produced by anterior pituitary extracts.

B. MUKERJI *and* R. C. GUHA, Calcutta.

Best and his co-workers (1932–1936) made the interesting observation that the feeding of choline chloride prevents the marked increase in the concentration of liver fat which occurs in rats on fasting, on cholesterol feeding and by diets rich in fats. They further observed that the injection of anterior pituitary extracts causes a considerable deposition of fat in the livers. In this communication, an attempt has been made to see whether the feeding of choline prevents the increase of liver fat produced by the injection of anterior pituitary extracts.

Three groups of rabbits were kept on a standard diet and treated as follows :—(*a*) Normal controls without any injection, (*b*) injection of anterior pituitary extract ; (*c*) choline feeding (500 mg/kg.) for 8 days and anterior pituitary injections. The rabbits were killed 20 hours after anterior pituitary injections and the content of liver fatty acids and their iodine numbers were determined. The average fatty acid content following injections of anterior pituitary extract was 6·50 per cent. The animals fed with choline chloride did not show any significant diminution in the concentration of liver fatty acids (5·82 per cent.) and there was no noticeable difference in the iodine numbers. It seems probable that the mechanism by which fatty livers are produced by injections of anterior pituitary extracts may not be the same as that responsible for causing fat deposition after cholesterol and fat feeding. The theoretical implications of these possibilities have been discussed.

47. The relative composition of blood and lymph in filarial infection.

R. N. CHOPRA, S. SUNDAR RAO, *and* S. N. MUKHERJI, Calcutta.

Estimations have been made of various components such as cholesterol, fatty acids, inorganic and organic phosphorus, albumen, pseudoglobulin and euglobulin of blood and lymph obtained from patients in different stages of filarial infection and the results are discussed. An appreciable increase in the cholesterol content of the blood of the affected persons is noticed. The lymph in filarial diseases appears to be exceptionally rich in proteins in relation to blood serum and is strikingly different in this respect from lymph obtained from cases of œdema due to other causes.

48. Ionisable iron in Indian food-stuffs.

J. C. PAL, K. L. ROY, *and* B. C. GUHA, Calcutta.

Although iron has been estimated in some Indian food-stuffs and dietaries, there is no record yet of the percentage of ionisable iron present, which is more important from the nutritional standpoint. The estimation of ionisable iron has, therefore, been carried out in a number of Indian food-stuffs and dietaries and it has been found that its content is considerably low compared with the total iron content. In the estimation of the value of a food-stuff, the ionisable iron content should receive major consideration, as on this will depend the absorption and utilization of iron in the body tissues.

49. A study of the dietary habits of some communities living at Calcutta.

D. D. Mitra, *Calcutta.*

In this paper an attempt has been made to find out statistically the number of times of consumption of some common articles of food per boy per day, amongst the four chief communities residing in Calcutta, viz: Bengali Hindus, Marwaris, Mahommedans and Anglo-Indians. The boys in general belong to the better off classes of their respective communities. The comparison has been made in terms of the 'daily index' which has been taken as the ratio of the number of times of daily consumption of a particular item of food to the number of children consuming it.

Data have been collected regarding nine common dietary constituents, viz. (i) rice, (ii) bread, (iii) pulses, (iv) vegetables, (v) fruits and nuts, (vi) milk and milk preparations, (vii) fish, (viii) eggs, and (ix) meat. A few typical examples of the maximum indices obtained are given below :—

Rice—1·6 (Bengali Hindus); bread—2·8 (Anglo-Indians); pulses—1·5 (Bengali Hindus); vegetable—2·4 (Bengali Hindus); fish—1·4 (Bengali Hindus); meat—1·3 (Mahammedans and Anglo-Indians).

It appears, among other points, that the Mohammedans and the Anglo-Indian boys take less often the pulses and vegetables and more often meat, fish and eggs than the Hindu boys.

50. Vitamins B_1 and B_2-content of a few common preparations of rice.

H. G. Biswas, Calcutta.

Chira (flattened rice), *Khai* (fried paddy) and *Muri* (fried rice) are important preparations of rice, widely used as supplementary diets by the masses of Bengal.

The biological assay of vitamins B_1 and B_2 of these food-stuffs was conducted on young albino rats. Five rats of each group deficient in vitamins B_1 and B_2 respectively were put on 2 grams. of each sample daily for 3 weeks and the average weekly growth was determined. The amount which fed daily to the deficient rats produces a weekly gain in weight of 10 g. for the above period, is regarded as the unit of those vitamins.

It was found that (1) (*a*) 100 g. country-made *Chira* from a coarse variety of *Aman* paddy gave 34·5 units Vitamin B_1 and 18·5 units Vitamin B_2. (*b*) 100 g. local fine *Chira* gave 22·5 units B_1 and 12·5 units B_2. (2) 100 g. local *Muri* gave 14·5 units B_1 and 11 units B_2. (3) 100 g. local *Khai* gave 13 units B_1 and 14 units B_2. Experimental details are given in the paper.

51. Nutritive value of the proteins of *Ruhee* (*Lobeo Rohita*) and *Hilsa* (*Clupea Ilisa*) by nitrogen alance bmethod.

K. P. Basu *and* H. N. De, Dacca.

An attempt has been made to estimate the 'biological value' and digestibility of the proteins derived from two common edible fishes available in Bengal under different conditions of treatment, e.g. steam-drying and sun-drying. It is found that the biological value of steam-dried *Ruhee* meal at 5, 10, and 15% levels of intake are 84, 78·8 and 73·3. The corresponding values for the steam-dried *Hilsa* are 78·6, 69·6 and 60·5. The biological value decreases with increase in the concentration of the protein.

There is no change in the digestibility of the protein. Biological value as well as the digestibility increases when the meal is prepared by drying in the sun. Lower biological value and digestibility in the case of steam-dried product is due to the effect of temperature on the quality of proteins. *Ruhee* fish is superior to the *Hilsa* fish as regards biological value as well as digestibility of its protein under both processes of preparation of the meal.

The supplementary effect of the *Ruhee* fish protein on the proteins of the pulses—*Lathyrus sativa* and Lentil is also observed. The protein values of *Ruhee* and *Hilsa* fish proteins under both processes of drying the fish at 10% level of intake are as follows :—

Steam-dried *Ruhee*	16·72	Steam-dried *Hilsa*	10·98
Sundried *Ruhee*	19·46	Sundried *Hilsa*	13·13

52. Nutritive value of the proteins of *Ruhee* (*Lobeo Rohita*) and *Hilsa* (*Clupea Ilisa*) by the growth of young rats.

K. P. Basu *and* H. N. De, Dacca.

Proteins of steam-dried *Ruhee* and *Hilsa* were fed at 5, 10, and 15 per cent. levels of intake. The growth per gram of protein at 10 and 15 p.c. levels are 1·55 and 1·86 in the case of steam-dried *Ruhee*, and 1·32 and 1·51 in the case of steam-dried *Hilsa*. When the protein of the diet is at 5 p.c. level, the value for *Ruhee* is 1·46 whereas in the case of *Hilsa* no growth is observed.

Rats on sundried *Ruhee* and *Hilsa* meal at 10 p.c. protein concentration show greater growth than those on steam-dried meals at the same level of intake. For the growth of young rats, however, *Ruhee* fish protein is immensely superior to that of *Hilsa* fish at all processes of drying. There appears to be a distinct difference in the rate of utilization of the proteins by male and female. This may be explained by the more rapid growth of male rats as compared with the female rats.

Marked supplemental effect of the *Ruhee* fish protein on the proteins of pulses as *Lathyrus sativa*, Field-pea, Green gram and Lentil is observed and this is of great practical importance in human dietetics. The maintenance requirement for rats varying from 50 grm. to 60 grm. of body weight appears to be 4 grm. of protein from these two pulses for a period of 8 weeks.

53. Determination of the Vitamin A content of the liver and body oils from *Ruhee* (*Lobeo Rohita*) and *Hilsa* (*Clupea Ilisa*) by the biological method.

K. P. Basu *and* H. N. De, Dacca.

The Vitamin A potency of the liver oil is higher in *Ruhee* fish than in *Hilsa*. The international units of Vitamin A contained in one grm. of the liver oils of *Ruhee* and *Hilsa* are 461 and 119 respectively. The potency of one grm. of the body oil of *Ruhee* is 127 international units while that of the *Hilsa* body oil is nil. The figures for unit values are computed by comparison with the International standard of Vitamin A (carotene) obtained from the nutritional research laboratory at Coonoor, South India.

54. The chemistry of bone extract.

C. A Rothenheim *and* S. S. Cowlagi, Bombay.

The paper deals with the preliminary results of the chemistry of an extract prepared from bone, blood and blood serum. The extract has the property of hastening the healing of broken bones where the natural process is slow. It also stiffens pseudarthrosis. Preliminary results show the presence of Na, K, P, and C, but the absence of histamin, or thyramin and of the already known bone ferments.

55. Biochemical studies in monkey hæmoglobinuria.

K. V. Krishnan *and* N. G. Pai, Calcutta.

Samples of blood from monkeys (splenectomised and non-splenectomised) infected with *P. knowlesi* were examined during the following stages of infection :—(1) normal state, (2) after splenectomy, (3) after infection and during incubation period, (4) during parasitological period, (5) final reading prior to the onset of either (*a*) hæmoglobinuria and death, or (*b*) non-hæmoglobinuria and death, or (*c*) cure. The constituents examined were: (1) cholesterol—total, free and ester, (2) total fatty acids, (3) phosphorus derivatives soluble in alcohol-ether mixture, e.g. lecithin and allied compounds classified as organic phosphorus, (4) inorganic phosphorus, (5) glucose. The results obtained showed that before the onset of hæmolysis and hæmoglobinuria, there is—(1) generally a fall in total cholesterol, (2) a rise in ester cholesterol indicating the production of fatty acid in the system, (3) *a marked fall in free cholesterol*, (4) a rise in inorganic and organic phosphorus, and (5) a marked fall in blood sugar. These results, specially No. 3, were characteristically different from those obtained for monkeys not developing hæmoglobinuria. Although hæmoglobinuria in monkeys is not completely similar to blackwater fever in man, the results suggest that the hæmolysin involved in human blackwater fever may be of the type of an unsaturated fatty acid which acts when free cholesterol is low.

Anatomy

56. The fate of the Duct of Cuvier in man and certain other mammals.

M. A. H. Siddiqi *and* R. V. Singh, Lucknow.

The large venous trunks in man and in eleven different types of mammals have been investigated. The arrangement of veins in the region of Superior Vena Cava and the coronary sinus has also been studied.

As a result of this investigation it is observed that three definite types of arrangement exist. These have been discussed from embryological standpoint.

57. The knee-joint in the climbing Marsupials.

B. M. Lal, Hyderabad (Deccan).

Three specimens were dissected—*Dasyurus viverrinus*, *Didelphys Aurita*, and *Dendrolagus Innatus*.

In all cases, the proximal surface of the head of the fibula takes part in the formation of the knee-joint, and articulates with the lateral condyle of the femur. There is considerable movement between tibia and fibula at the proximal tibio-fibular joint. The joint is capable of forward and backward movement and a certain amount of rotation. As the fibula is in contact with the lateral condyle of the femur during the flexion of the knee-joint, when the tibia and fibula are forcibly pressed together by the action of the popliteus and the tibio-fibular interosseous muscle, the forward and inward movement of the fibula causes the knee-joint to extend with considerable force. This action is necessary in these animals on account of a feeble cartilaginous patella, which is unable to give sufficient leverage to quadriceps femoris. The extension thus started is carried on by the external or fibular collateral ligament dragging the femur above the axis of rotation after the advancing head of the fibula. The movement at the proximal tibio-fibular joint and the articulation of the head of the fibula with the lateral condyle of the femur is a vestige of the reptilean joint. Popliteus muscle does not gain origin from the lateral condyle of the femur, but only from the proximal part of the fibula and the action of the muscle is not of flexion, but rather pronation. The muscle is continuous with the lateral meniscus of the knee-joint indicating the derivation of the ligament from that muscle.

The knee-joint is primitive in these marsupials in the following respects:—

1. The head of the fibula articulates with the lateral condyle of the femur and takes part in the formation of the knee-joint.
2. There is movement between the fibula and the tibia in the proximal tibio-fibular joint.
3. The patella is cartilaginous.
4. Some of the ligaments are doubled.
5. The rotular surface of the femur is shallow or flat.

58. Some features of interest in the posterior limb of 'Paradoxurus Niger' commonly known as 'Bijju'.

B. M. Lal, Hyderabad (Deccan).

The mesogluteus and ectogluteus muscles have a caudal origin and are associated with the muscle Ischiofemoris which possesses caudal and ischial heads of origin. Hamstring mass possesses the caudal head, Flexor Caput dorsale which arises from the vertebræ and joins the Semitendinosus muscle. The Ectogluteus muscle and Adductor Magnus and Tensor Fascia lata are laminated. The Tibialis posterior, the tibia and fibular flexors form one muscular mass.

The chief primitive characters in the animal are: lamination of some of the muscles; absence of the origin of ectogluteus muscle from the ilium; survival of the caudal head of origin of flexor cruris muscle; presence of Ischiofemoris and Tennissimus muscles, and undifferentiated soleus muscle and a very large Plantaris muscle.

59. Development and abnormalities of the heart.

H. Hyder Ali Khan, Hyderabad (Deccan).

The pericardial area is a mass of Mesoderm situated in the extreme cephalic end of the embryo (Fig. 1). Two primitive Aortae appear in this region and are joined by vitelline veins from the yolk-sac and the umbilical veins. As the embryo is bent the pericardial area is brought down and the primitive aorta is also bent giving rise to the ventral aorta, the first arch and the dorsal aorta. The caudal portions of the two ventral aortæ fuse together to form a heart tube which receives the vitelline veins, the umbilical veins, and the precardinal and postcardinal veins from the cephalic and caudal portion of the body unite into a single trunk called the Duct of Cuvier (Fig. 2). The heart tube contracts rhythmically and maintains the circulation. Constrictions divide the heart tube into the truncus arteriosus, bulbus cordis, ventricle, atrium and sinus venosus (Fig. 3). The truncus arteriosus splits into the pulmonary artery and the ascending aorta; the bulbus cordis and ventricle from the mature ventricle, and the atrium and the sinus venosus become the mature atrium. Two elevations the endocardial cushions grow in the atrial canal from the septum intermedium and divide the canal into right and left (Fig. 4). Septum primum grows into the atrium and joins the septum intermedium; the opening between the two is called the ostium primum of Born. Before the opening is closed another opening ostium secundum of Born is formed in the septum primum. The development of septum secundum acts as a flap valve till birth and allows blood to flow from right to the left atrium only. This opening is foramen ovale. After birth the two septa fuse and the foramen ovale is closed. The ventricle is divided into right and left by the crescentic septum inferius which develops upwards (Fig. 5). Four endocardial cushions appear in the bulbus cordis, the two lateral again divide into two each. The ventral pair together with the ventral cushion form the pulmonary valves and the dorsal pair together with dorsal endocardial cushion form the aortic valves (Fig. 6). The atrioventricular valves are derived from the septum intermedium medially and the invagination of the atrial canal laterally.

Abnormalities. (*In position.*) The heart may fail to descend (cervical heart), may pass in the abdomen through a diaphragmatic hernia, may be situated on the right side, dextrocordis (accompanied by transposition of the viscera), thoracic wall being deficient—ectopia cordis.

(*In structure.*) Abnormality may effect the septum, the openings, the valves or the great vessels, such abnormalities being multiple. Incomplete development of the interatrial septa (patent foramen ovale) is usually accompanied by a patent ductus arteriosus and stenosis of the pulmonary artery. Deficiency in the septum inferius (with only one ventricle). Deficiency of valve due to incomplete development of endocardial cushions. Over-development of the endocardial cushions causes stenosis. The main vessels may be absent or transposed and lastly the ductus arteriosus may remain patent.

These conditions, though usually serious, sometimes do not cause any symptoms during the early age. The case of S.B. aged 10 with clinical signs of pulmonary stenosis caused no untowards symptoms nor was there any marked hypertrophy of the right ventricle (Fig. 7). Electrocardiogram.

Miscellaneous

60. A simple method of staining reticulocytes.

C. R. Das Gupta, Calcutta.

The enumeration of reticulocytes is of great value clinically as it is a helpful adjunct in the diagnosis of different types of anæmia. Prognostically also this is of great help as the count offers a most valuable means of estimating the therapeutic activity of any hæmatinic medication.

To demonstrate the reticulation in the immature erythrocytes, brilliant cresyl blue is the dye of choice. The following technique has given satisfactory results in the hands of the writer. An equal amount of oxalated blood and 1% brilliant cresyl blue in 0·85% NaCl is mixed together in a test tube. A small drop of the mixture is put on a grease-free scrupulously clean slide on the top of which an equally clean coverslip is put—the pressure of the coverslip will give an evenly spread smear. It is now sealed with melted wax and examined in the usual way. With this method there is no clumping, crenation or breaking down of the cells and the reticulocytes stain very well giving a much higher count than the counts obtained by ordinary methods.

61. Adsorption of hydrogen ions by serum globulin and its antibody.

M. M. Biswas, Calcutta.

Titration curves have been drawn with pure pseudoglobulin of normal horse serum and its antibody using N/10 solutions of hydrochloric and oxalic acids, baryta and caustic soda. Both the globulins adsorb $H^{\cdot}$ ions from the acids in a parallel way. Above pH$=5{\cdot}0$ titration with baryta shows no abnormality; whereas the behaviour with sodium hydroxide suggests that normal globulin possesses a stronger affinity for $H^{\cdot}$ ions than the antibody globulin at a higher level of pH than the isoelectric point. This abnormality has been attributed to a differential behaviour of the globulins probably due to certain characteristic end-groupings developed in the antibody during the process of immunization.

62. Rôle of formalin in the estimation of nitrogen in body fluids.

PREMANKUR DE *and* C. C. CHATTERJEE, Calcutta.

In estimating urea, non-protein nitrogen, albumin, etc., the nitrogen is first converted into ammonium salts, and from this ammonium salt the amount of the original substance can be calculated. When a neutral solution of formalin is added to a neutral solution of ammonium salt, an equivalent amount of acid is liberated. This acid is titrated by a standard alkali and from the result of this titration the nitrogen present in the material is calculated. This process has been used as a substitute for Nesslerization and also for controlling the result of back-titration. The method is quick, economic and easily controlled and gives equally accurate results.

SECTION OF PSYCHOLOGY

President:—G. Bose, D.Sc., M.B. F.N.I.

Sensation, Perception and Memory

1. D.L. for lifted weights increased continuously.

Gopeswar Pal, Calcutta.

The problem has been approached in two different ways: (1) Standard weight which was lifted by observers was increased continuously at definite rates till just noticeable difference was reported. D.L. values were calculated from the rate of increase and the time that elapsed before difference could be just apprehended. (2) Standard weight was increased continuously at definite rates till it reached definite amounts. Judgments of ' yes ' or ' no ' regarding increase in heaviness were recorded after the end of each experiment. D.L. values were calculated from ' yes ' judgments using the constant process.

The chief findings are as follows: (1) With the increase of the rate of change, D.L. value rises gradually. It reaches its maximum when the rate becomes medium, after this the value falls gradually and it attains its minimum when the rate attains its maximum limit. (2) D.L. values obtained by the ordinary method are lower than the values obtained by the present method. (3) Ratios of D.L. values to standard weights have not been found to be constant.

An attempt has been made in the paper to explaint he reasons of the different findings chiefly in terms of attention and muscular adjustment.

2. Psychology of illusion.

S. N. Roy, Patna.

In this paper an attempt has been made to disprove the theory that illusion is false perception. Strictly speaking, ' right ' and ' wrong ' are terms which are not applicable to perception, and if we do apply them we go beyond the scope of psychology proper. It has been also pointed out that no sharp line can be drawn between right and wrong perception, because every perception involves at least a minimum of illusory experience. The object of perception is determined by the act of meaning which perception involves and this act of meaning is determined by a mental set and as such the object meant cannot be said to be identical with the ' thing '.

Perception may be treated as the function of a total situation and the object of perception as determined by this function. The mathematical notion of function can be conveniently applied to perception and thereby the variable factors can be adequately explained.

3. The effect of attitude on the pressure or contact sensation.

K. C. Mukherji, Dacca.

An attempt has been made in this experiment to determine the influence of active and passive attitudes of mind on the continuation of contact sensation and of its after-effects. The results obtained in this experiment are categorically the same as found by Hayes, Dimmick and Swindle. But their experiments were of a different nature in which the causes of the results were not at all revealed.

4. Peculiarities in tactual adaptation.

S. K. Bose, Calcutta.

Duration of tactual sensation and conditions for its persistence and disappearance have been studied in co-operation with untrained and highly trained subjects by placing weights of various dimensions on different parts of the hand. Introspective account reveals interesting peculiarities in adaptation.

5. Different levels of errors in memory reproduction.

J. K. Sarkar, Muzaffarpore.

Experimental results clearly indicate two levels of errors in reproduction. A high correlation is found to exist between the nature of the lower type of errors in reproduction and persistence. The higher level definitely shows non-persistence. A close association between non-persistence of errors and intelligence has been established. Besides the above two types of errors, the study indicates the existence of other types which involve the features of persistence and non-persistence in different proportions. The paper concludes with a suggestion about the probable cause of different types of errors.

Emotion

6. A further note on the judgment of facial expression of emotions.

N. S. N. Sastry, Mysore.

The paper is a modification (in regard to experimental procedure only) and continuation of a similar one submitted last year.

The previous investigations on judgment of emotional expressions show that the situation element in the case of an emotional expression has not been sufficiently emphasized.

Twenty-four photographs of emotional expressions (Feleky) were presented to 124 subjects. Correct number of responses, when unaided by titles and aided by such titles, were noted down. The average percentage of success is only 34.

Fifty patients were asked to indicate 10 objects or situations which could serve as stimuli for the 24 emotional expressions. The frequency of such situations or objects was worked out. This served as the basis of a test that was built. The subjects were asked to match the photos with the situations printed. Correct responses came to 85%. So the superiority of the second test over the first one is

$$\frac{85-34}{34} = 1\ 5.$$

The fact that situation should thus help correct judgment makes one believe that the judgment is a result of deduction from situation.

7. Further study on the induction of emotional states in laboratory experiments.

M. N. SAMANTA, Calcutta.

In a preliminary report on the study of emotion by the pneumographic method, the tentative conclusion was drawn that emotion is best induced in the laboratory by musical notes. The records obtained under musical stimulation, however, showed variations in two opposite directions even in the same emotional state. In some the respiration became rapid while in others it slowed down. An attempt has been made in this paper to explain these phenomena.

Fatigue

8. Affective influences in mental fatigue.

C. S. MYERS, London.

In the isolated striated *muscle* fatigue is ascribed: (*a*) to the exhaustion of intra-cellular material essential for its contractility, (*b*) to the accumulation of the toxic products of its activity. But in the intact living organism such muscle is largely safeguarded initially from (*a*) and (*b*) by inhibitory, afferent impulses, mainly reflex and proprioceptive.

Is it not therefore likely that the observed effects of prolonged *mental* activity are due initially not so much to fatigue in the corresponding senses of (*a*) or (*b*) as to the protective actions of affective mental processes? It is recognized that instinctive activities are maintained by various emotional affects: anger, for example, prevents any other conative process from interfering with combat. So too, voluntary attention, essential for conscious intellectual activity, is maintained by the affective factor of interest, spontaneous or enforced. With prolonged attention, the feelings first of boredom, later of weariness, replace the feeling of interest. It is suggested that each of the two former exercises an inhibitory function on attention, protecting it against true fatigue. These afferent inhibitions may conceivably spread so as to terminate the previously successful repression from consciousness of conflicting ' complexes ' and to arouse, consequently, feelings of irritation, worry and anxiety, all preventive of the normal exercise of attention and leading to disorderly and uncoordinated mental and outward behaviour.

9. Psychological significance of ergographic curves.

H. P. MAITI, Calcutta.

Psychological study of ergographic curves has considerably suffered from a physiological bias in the past. The present study is a continuation of a paper contributed to a previous session of the Indian Science Congress (1935) and entitled ' Ergograph as a diagnostic aid in Psychiatry '. It shows that an ergogram has individual characteristics which remain more or less constant and which can be interpreted psychologically. A comparative study of ergograms of normal and mentally diseased persons is attempted.

10. A study of ' big muscle ' ergographic curves.

ANATHNATH DATTA, Calcutta.

(Communicated through G. Bose.)

An attempt has been made in this paper to study some of the peculiarities of the ergogram as recorded in Big Muscle Ergograph devised by Dr. G. Bose. A comparative study has also been made to show the difference in the nature of the work of the big muscles and small muscles.

Education and Mental Tests

11. The nature of 'M' factor.

K. G. R. Rao, Madras.

A factor analysis of Cox's tests of mechanical ability, as best representing mechanical ability tests in general, may be expected to throw light on the nature of 'M' factor.

Cox and others have isolated a group factor, 'M', running through tests of mechanical ability. This factor has been differently explained by other workers as 'mechanical intelligence', 'spatial ability' and a differential influence of 'experience'.

The present study involving factorization of Cox's tests has shown evidence of the presence of three factors of varying magnitude. They are: 'g' measured by the non-verbal primarily perceptual tests, a verbal factor, and a factor 'M' which is observed for boys only. It is suggested here that this factor 'M' is attributable to a special experience reserved for boys only—a special interest in toys and models of mechanical kind.

A reference is made to the possible bearing of the result upon school work.

12. A comparative study of scores in selected items of Terman's 'logical selection' and Burt's 'reasoning' (modified) tests.

S. Jalota, Lahore.

The answers of 1,856 students have been considered in this paper.

The comparison is based upon the values of (i) inter-correlation and (ii) the deviation from normality (Pearson's β_2).

The correlations between the scores in logical selection and reasoning are low, ranging from +·178 to +·495. But the correlations of the above tests with the total-score for the test-battery are fairly high (+·6 to +·8). The correlation value of reasoning with the 'totals' is uniformly higher. The reasoning-scores also show better normal distribution. It is argued therefore that the two items are tests of very different mental abilities. If Burt's items be taken to agree with normal reasoning situation, then it follows that Terman's 'logical selection' is a misnomer.

13. A short report of group intelligence tests on certain school students.

S. Sinha, Calcutta.

The writer of the paper carried out the work on some high school students under the Calcutta University. Attempt has been made to construct questions for tests in the Bengali language and to standardize the same under different age groups of both the sexes. In general, it has been found that the girls are a bit inferior to the boys in intelligence. This finding is a tentative one as the tests have not been carried out in a sufficient number of cases. A peculiarity is marked at the age group of 15 years, where it was found that the girls are not inferior to the boys in intelligence. The writer advocates the necessity of stressing the reading of books outside the curriculum.

14. A study of writing ability of school boys in Bengal.

H. C. Banerji, Dacca.

Boys' handwriting shows great individual differences both in quality and speed. So training in schools should be adjusted to individual differences and needs. The use of handwriting scales has shown that the high degrees of quality at the expense of speed are not to be insisted on in schools, but regular short practices in speed writing should be given when boys have reached the minimum standard for quality.

An experiment was made at Dacca for the measurement of the speed of writing of boys of different classes in a high school and the results show that the rate in letters per minute decreases but variability increases with the increase in time given for writing from one minute to two minutes and from two minutes to four minutes.

15. A study of the handwriting of children in school.

(MISS) R. GHOSH, Calcutta.

Importance of handwriting as a school subject is pointed out. The present study begins with application of tests of handwriting to different groups of children, the grouping being done according to forms and ages.

The actual experiment was performed with girls of the Gokhale Memorial School in Calcutta. Handwritings can be classified as good, average and bad, according to models adopted as norms for different groups. A comparison is made between the handwriting ability of different groups and of individual pupils. The various educational uses of handwriting tests are pointed out. The paper concludes with reference to certain factors that affect handwriting ability.

16. An experimental study of errors in reasoning.

D. RAMAKRISHNIAH, Mysore.

In this investigation errors in reasoning due to predispositions and sentiments were studied experimentally by means of tests in reasoning. The tests consisted of syllogisms involving emotional bias and retentive bias, the bias being either in favour of acceptance or of rejection of a suggested conclusion.

Example of an emotional bias for the acceptance of the suggested conclusion :—

Many students are pretty.
Some girls are students.
∴ *Some girls are pretty.*

The tests were administered to two groups of University students : (i) students of Logic ; (ii) students who had not studied Logic.

It has been found that both Logic and non-Logic students yield to the suggestion, whether the suggested conclusion is logically valid or not. 81% of the responses of the non-Logic students are affected by their sentiments and prejudices in drawing syllogistic inferences, while only about 38% of the responses of Logic students are similarly affected. Further, it has been noted that for non-Logic students errors created by predisposition are greater than errors caused by emotional prejudices (85% versus 77%) ; whereas for Logic students there is not much difference as between emotional and non-emotional prejudices.

17. Experiments in the teaching of oral expression in English

K. D. GHOSH, Calcutta.

The paper deals with certain experiments in developing oral expression in English that were conducted by the writer in classes VI, VII, VIII and IX of the Ballygunj Demonstration School for about a period of two years. They are carefully graded in difficulty and calculated to develop simplicity, clarity, accuracy and facility in oral expression. They are to a certain extent modelled on experiments successfully carried out in a few progressive institutions in England, Australia, and France. The results obtained at Ballygunj were very satisfactory. The paper describes at length the procedure in connection with each of the experiments.

18. Child psychology and behaviour.

U. S. Gheba, New Delhi.

Behaviour is the product of heredity and environment, both objective and subjective. Unhealthy environment is responsible for infant mortality, diseases of children and misbehaviour. The causal connections in mental life become clear from the relation of Mind and Body as expounded in Dr. G. Bose's new theory of mental life. It is necessary to study behaviour development from birth to maturity.

The child's behaviour may be profitably studied from the standpoint of gestalt psychology in terms of (i) behaviour-patterns, or from the standpoint of analytic psychology in terms of (ii) extroversion and introversion, or again from the standpoint of psychoanalysis in terms of (iii) oral and genital fixations.

Psychiatry and Psychoanalysis

19. A case of 'strephosymbolia' (word-blindness).

Owen Berkeley-Hill, Ranchi.

History of case. Views of S. T. Orton, who coined the term 'strephosymbolia', to the effect that this disability is due to a failure in the establishment of complete dominance in one or other cerebral hemisphere. Criticism of 'dominance' theory. Views of James Hinshelwood who looked for an analogy between acquired and congenital dyslexia. Observations of Lucy G. Fildes and her criticisms of Hinshelwood's view. Study of dyslexia by Marion Monroe who has formulated a 'reading index'. Practical value of her opinion that approximately twelve per cent. of the general population have reading disabilities of some sort.

20. Some ætiological factors in the pathology of stammering.

I. Latif, Lahore.

The object of this paper is to attempt an analysis of a few ætiological factors in the onset and cure of stammering by presenting two sample cases from our clinical investigations. These cases by no means exhaust all the possible causes of stammering. Nevertheless, each one of them is sufficiently unique in character to illustrate that the causes of stammering vary enormously from one case to another. A mass treatment of the pathology of stammering is, therefore, inadequate.

21. Dream character of religious sexual abstinence.

S. L. Sarkar, Calcutta.

Connotation of the term 'religious sexual abstinence'. It is not merely an acceptance of Hindu convention. The element of religious experience brings about profound psychological changes. There are two classes of dreams. One class is meant for giving relief to the damned up libido. Another class of dreams appears to give a training to the unconscious to avoid sexual imageries and thoughts and thus to maintain sexual abstinence. Some peculiarities in the structure of the latter class of dreams are pointed out.

22. Psychic disorder as a phase in the life of certain mystics.

N. N. SENGUPTA, Lucknow.

The doctrinal literatures of *Vaishnavism, Shaivism* and of *Tantrik* cults sometimes refer to a condition of psychic disorder which is said to appear in the course of mystic life. The disorders seem to belong to four types : (1) Mainly psychic disorders characterized by illusory perceptions and delusions, (ii) Physical changes usually associated with emotional states, (iii) Certain asthenic changes, (iv) Certain exaggerated motor phenomena. All these symptoms are usually of a temporary nature.

The symptoms of disorder seem to serve certain definite purposes in the economy of mystic life : (i) they break up old habit-patterns, (ii) they serve to break the contact between the mind of the individual and the objects of the environment. In both of these ways, the process of unbalance makes introversion, which seems to be an essential step to mystic life, easy.

It is possible to understand the general scheme of psycho-physical processes that bring about these states of disorder. (i) On the one side, the break with the external world leads to a new arrangement of mental functions. The psychic disorder appears in the period of transition between the break and the reorganization. (ii) On the other side, the release from the strain of adaptation implies emotion. It also implies a change in the organic condition. These influence the *thalamus* which in its turn influences the general course of consciousness. (iii) Again, it is held by Bianchi that most of the organic changes have their representation in the *cerebral mantle*, especially the *sigmoid gyrus*. The change in the condition of this region by the altered working of the circulatory, respiratory and the sexual systems may explain the occurrence of various physical symptoms noted above. It may also account for a general change in the character of mental states with respect to their order and intensity.

23. Concept of time.

S. C. LAHA, Calcutta.

(Communicated through G. Bose.)

Time sense is variable. It expands and contracts. In animals, primitive people and children, it is undeveloped. The causes of time-sense have been incorrectly ascribed to perception of events and memory-pictures ; but as a matter of fact it is primary and is quite independent of them. It is stretched in pathological anxiety and contracted in Schizophrenia and depression. It depends on the capacity of the libido to attach itself to external objects. It appears in a crude form whenever there is an actual danger to narcissistic libido ; but in civilized man it is mainly the result of conflict and appears whenever there is a resistance to the free flow of the unconscious libido . A highly developed time-sense is an artificial product of civilization and is not inherent in our psyche.

24. Psychology of fetishism.

M. Z. ABDIN, Bhagalpore.

Psychologists are not agreed as to the origin of fetish. Fetish plays an important part in sex-relationships of human beings both normal and abnormal.

Freud regards fetish as a penis substitute; his contention, that all fetish objects most frequently met with, such as shoes, stockings and underwears, are penis symbols, is not convincing, because shoes and stockings are more appropriately symbols of vagina, being receptacles. It cannot be said that breast and buttocks are penis substitutes. The views of Stekel and others are equally unsatisfactory. But all are agreed that the origin of fetish lies in childhood experiences.

The view advanced in this paper is that the origin of fetish lies in the baby's experiences at the breast of the mother. All fetish objects are substitutes for mother's breasts. It is for this reason that round and smooth objects form the commonest objects of fetish. This view is quite in line with the psycho-analytical standpoint that the breast of the mother is the first object of love and its substitutes, therefore, are subjective excitants of love, by sight or contact.

25. Unconscious factor in skin-colour preference.

D. DATTA, Calcutta.

(Communicated through H. P. Maiti.)

In this short paper certain tendencies in skin-colour preference have been noted and an attempt has been made to interpret them by the mechanism of repression.

26. The Oedipus wish in Hindu icons.

RANGIN HALDER, Patna.

Hindu icons offer important corroborative materials in support of Dr. G. Bose's theory of the genesis and adjustment of the Oedipus wish. Thus the *Sadyōjāta* (*Umā S'ivajananī*) the *Mahiṣāsuramardinī*, the head-and-hair-offering images and the *Arddhanārīśvara* images are considered to represent respectively the passive rôle of the child, the ego-identity stage, the castration wish and the active homosexual attitude towards the father. A new theory about the origin of *Linga* worship as a perfect symbol for the Oedipus wish is formulated. The solitary *Linga* stands for the castrated *membrum virile* of the father imago. The worship of the *Linga* helps the son to identify himself with it and the *Yoni* motif which comes later serves to satisfy the Oedipus incest wish the culmination of which is to be found in the *Mahāmāyā* image.

Social Psychology

27. Psychological basis of earthquake rumours.

JAMUNA PROSAD, Patna.

The great Indian earthquake of January 15th, 1934, was closely followed by a period of panic in which a large number of rumours arose quickly and spread widely. Two classes of these rumours, viz., explanatory and astrological, are discussed in the light of psycho-analysis. The explanatory rumours ascribe the earthquake to sin as its cause; and the astrological rumours prophesy further disasters as punishment for sins. The main themes of rumours are therefore the sin and punishment phantasies. Since empirical and rational considerations did not justify the wild rumours, they must be held to be creations of neurotic insecurity and anxiety set up by the catastrophic experience of the earthquake. The anxiety may be traced to the conflict between the regressive desire for life in accordance with the vegetative and animal tendencies, and life in accordance with the developmental impulse towards the attainment of the ideal of self-dependent individuality.

The facts of transmission of rumours and participation in them are social phenomena, not reducible to the effects of common complexes in all cases. They imply the quest for a social solidarity through which an intra-mental security is established in order to counterbalance the internal and ever-present insecurity and anxiety caused by the constant and usually unconscious internal clash between instinct and ideal.

28. Juvenile delinquency—a study.

J. M. SEN, Krishnagar.

The writer of the paper had studied the problem of juvenile delinquency in Calcutta in some of its aspects. No less than 10,222 cases were examined. Contributory causes were examined and although several factors were simultaneously present in many cases the following groupings were made :—(*a*) defective discipline, specific instincts, general emotional instability and morbid emotional conditions ; (*b*) a family history of intellectual weakness, defective family relationships, a family history of temperamental disorder or of insanity or the like, a family history of physical weakness, poverty and its concomitants ; (*c*) intellectual disabilities, detrimental interests together with a lack of up-lifting pursuits and developmental conditions such as adolescence or precocity in growth ; (*d*) physical infirmity or weakness in the offender himself.

Detailed information regarding the boys sent to the Reformatory and Industrial schools at Alipore for the years 1935 and 1936 has been given in the paper ; history of typical cases while at the Reformatory and Industrial schools has also been furnished.

29. Dreams of the Garos.

T. C. SINHA, Shusung.

The paper records the different types of dreams of the Garos and the interpretations put forward by them. An attempt has been made to find out the laws which govern the interpretation.

30. Certain factors in sex preference.

D. AGARWALLA, H. ROY, *and* A. BISI.

(Communicated through M. N. Banerji.)

The paper is based on a questionnaire study of the attraction of males for females of different ages and for different parts of the female body. Certain definite tendencies have been indicated.

Hindu Psychology

31. A study of the psychophysical aspect of prānāyāma.

RAJ NARAIN, Lucknow.

(Communicated through N. N. Sen Gupta.)

Prānāyāma or voluntary control and regulation of breath has been a constant feature of Indian mystic life and discipline. In the Vedas prānāyāma appears as an element of ritual. Some of the later Upanisads treat it as an adjunct to spiritual culture. Patanjali regarded it as one of the eight aids to yoga. In *Hatha* and *Kundalini* yoga it assumes a far greater significance in the disciplinary scheme. In the *Svarodaya-sāstra* it flowers into an exclusive method of spiritual advancement. Buddhist mysticism also incorporates regulation of breath as an ingredient of mystic culture. Jaina yoga alone recognizes the spiritual value of prānāyāma in a half-hearted fashion.

Prānāyāma has been claimed to produce varied results. Some of these results are obviously of a magical nature ; these fall outside the scope of our enquiry. Others, however, possess a psychophysical value. The paper attempts to understand and explain the process by which the psychophysical results of prānāyāma are produced, and the bearing of these results on the development of mystic life and consciousness.

32. The science of psychic equilibrium.

S. P. ARANYA, Faridpur.

This paper deals with the 'Yoga-Nirvana' cult depicting the method of psychical emancipation from all miseries. It ends by explaining how 'Moksha' of absolute psychic equilibrium is attained by psychological discipline in stages.

33. Principles of Hindu physiological psychology.

M. N. BANERJI, Calcutta.

In this paper have been discussed the Hindu concept of mind, the peculiarities of the sense-organ, and the centres of mental activities. An attempt has been made to interpret the Hindu classification of matter from the psychological standpoint. The Hindu idea that matter and mind are both material has been discussed and the principle of resonance between sense-organs and stimuli has been elaborated. The Samkhya system of Gunas has also been explained and the theory of *Vayu*, *Pitta* and *Kapha* has been dealt with.

General Problems

34. Psychological study of language (preliminary communication).

G. BOSE, SAILENDRA KRISHNA LAHA, *and* D. GANGULI, Calcutta.

Not much systematic effort has hitherto been made to study language as a whole from the psychological standpoint. The present paper gives an account of the main findings of the writers. It has been found that the human mind, although it acquires abstract concepts from concrete experiences and apparently regards the former as something quite different from the latter, in actual practice converts the abstractions into concrete ideas. The syntax of a language is an index of certain racial characteristics. There is linguistic evidence to show that the European nations are more interested in action than in objects whereas the Indian nations have a preference of objects to actions. Language shows that the human ego exhibits a curious behaviour inasmuch as it tries to deny all changes within itself and makes an effort to project its own experiences into the outer world, itself remaining immaculate. The importance of the different types of libido in shaping linguistic expressions has also been pointed out.

35. The nature of consciousness as immediately observable.

R. M. LOOMBA, Lucknow.

The descriptions of the nature of consciousness as immediately observable as given by James, Wundt, Stout and Ward, as well as McDougall's characterization of mental structure as a conceptual construction are found unsatisfactory. The paper suggests a comprehensive reformulation (i) on the basis of the distinction between immediate consciousness and discriminate cognition recognized in some manner by all these psychologists; the former is (ii) a successive but continuous flow of change of psychoses; (iii) in which fluid constituents including (*a*) substantive parts, (*b*) transitive segments, (*c*) tendencies, (*d*) overtones and fringes, and (*e*) moments of heightened activity or dullness, acceleration or retardation and the like must be recognized with their inherent affinities and spontaneous groupings; (iv) which possesses a feeling of individuality as a whole, (v) without a subject-object antithesis arising; and (vi) to which selective emphasis cannot be attributed. Its nature determines the character of psychic entities in determinate cognition, which arise by spontaneous use of the mind for adaptation and adjustment. Yet they are conceptual constructions to the extent that abstraction, definition and correlation play a rôle in discriminative attention.

36. Criteria of normality.

H. P. Maiti, Calcutta.

The ideas of the Normal and the Abnormal belong primarily to the domain of sociology, for these ideas originate in the course of social interaction of individuals. An examination of the conditions of their arousal indicates the influence of psychological factors. Psychology, on the other hand, begins its work by accepting certain concepts of the normal and the abnormal. After referring to the relation between the two sciences, the paper discusses how far sociology and psychology can agree about the criteria of normality from their respective standpoints. Three concepts of the normal—Social, Naturalistic, and Statistical—are critically examined in this connection. The paper concludes with a few suggestions about ' dynamic ' criteria of the normal.

37. Examination of ' Intelligence '.

C. E. Spearman, London.

The original and still current theory of ability is based on the concept of ' faculties '. The only other widespread alternative is the comparatively modern theory of ' types '. Both suffer from two fatal defects; one is their extraordinary lack of definite meaning; the other is their failure to fulfil the primary scientific requirement, that of generality. For the most part, the examinations have to contend with many further grave deficiencies; amongst other things, success is apt to depend unduly on the hap of previous experience, on the language employed, and on an obscure mixture of other influences. All these faults can be more or less eliminated by means of the new theory of ' factors '.

Of these by far the most important is the one called by the letter ' G ', which enters into all abilities whatever. It is the principal constituent, and only stable one, in all conceptions or measurements of ' intelligence '.

The other chief cognitive factors are those designated as V, M, F, P, O.

To all these constituents of cognitive ability there must be added W, which governs their employment. These seven factors certainly do not exhaust the whole ' personality ', or even the whole of what may conceivably be entitled ' intelligence '. But they do go a long way towards doing so. In particular, several of them (including G) admit of valid comparisons between nationalities and races, that speak different languages.

* * *